Apartment Houses

by

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with special chapters contributed by Clifford Strock, H. M. Nugent and W. H. Easton, Jr., and Alfred Geiffert.

PROGRESSIVE ARCHITECTURE LIBRARY

REINHOLD PUBLISHING CORPORATION

330 West 42nd Street New York, U. S. A.

Printed in U. S. A. by The Maple Press Co.

FOREWORD

The purpose of this book is to suggest methods of attacking the problem of apartment design rather than to present a series of ready-made solutions. Each type of site encountered and every type of occupancy that must be provided for presents its own individual problem and a solution must, in each case, be sought consistent with the ends desired. It is my hope that the methods of planning and analysis presented here will prove useful in accomplishing this purpose.

I have not hesitated to draw freely on the ideas and thoughts of many writers on the subject, and particularly on the books and articles listed in the bibliography at the end of this volume. I am indebted to my wife for many ideas and criticisms and for her skill in transcribing my complicated and somewhat illegible manuscript to clear typing; to my partner, Julian E. Berla, for many valuable suggestions, to Nicholas Satterlee for his many long hours of work spent in preparing the drawings which illustrate the architectural section of the book.

Joseph Henry Abel

Full blame for writing the Structural Engineering section of this book must fall on Jeffrey H. Livingstone, who convinced me that book writing is child's play. But to his credit must be said that he and Mr. Stamo Papadaki did everything they could to help me make it so.

In collecting and presenting material I am heavily indebted to all the members of the firm, particularly the "inner circle" of Max Krueger, E. G. Elstad, V. Buergin, P. J. Lindstrom, Joseph Fraioli, and W. Blum, as well as principal engineers such as W. Gottschalk, A. J. Perrone, T. C. Kline, K. B. Ideman, B. Brurock Harstead and last, but not least, James Lyall, who transformed my ideas into sketches.

Fred Severud

As Editor of the PROGRESSIVE ARCHITECTURE LIBRARY series, I wish to express my sincere appreciation to Joseph H. Abel, Fred N. Severud, Clifford C. Strock, H. M. Nugent and W. H. Easton, Jr, and Alfred Geiffert for the material which they have contributed to this book and for the time and effort which they have so willingly given to the cause of better architecture.

I also wish to express thanks to Stamo Papadaki who worked so closely with me in designing the book and Alberta Gordon who was my assistant.

Jeffrey H. Livingstone

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BY JOSEPH H. ABEL

CHAPTER 1: The Problem

What and Why Is an Apartment Building

To the owner, an apartment building is primarily a means of making money, either through sale or as an investment; to the occupant of one of its units, it is a home; and to the conscientious architect desirous of doing his duty towards both client and tenant, it is an interesting and often difficult problem. The architect must see to it that the owner makes money and that the tenant has as good a place as possible in which to live. However, these seemingly divergent aims are not really so far apart as might appear at first glance, because it is a fact that the buildings which best satisfy the occupant's needs and desires, at a price which he can afford to pay, in the long run make the most money for their owners.

Buildings crowded onto small crooked lots, forced into odd shapes in an attempt to squeeze in the last possible room, may show a high return on paper, but except during periods of extreme housing shortages such units generally are avoided by prospective renters. When there is competition for tenants the well designed building, offering attractive, livable apartment units, will prove its worth by retaining a high percentage of its occupants and by attracting new ones, while buildings of inferior design, offering less desirable living conditions, will suffer from excessive vacancies or will be forced to reduce rents to a much lower level in order to attract tenants (Fig. 1). There is too great a tendency on the part of builders to ignore the subject of vacancies in making decisions about apartment planning.

In a building of even moderate size the amount that may be lost through vacancies in undesirable units may be far more than the cost of adding a few amenities that will serve to keep up rentals and keep the apartments occupied through highly competitive periods. Money thus invested will show a high return over a period of years. It should be emphasized here, that by amenities is meant adequate and properly laid out living space, finishes that are durable and require a minimum of housekeeping on the part of the occupant, ample light and air, and a view of something other than

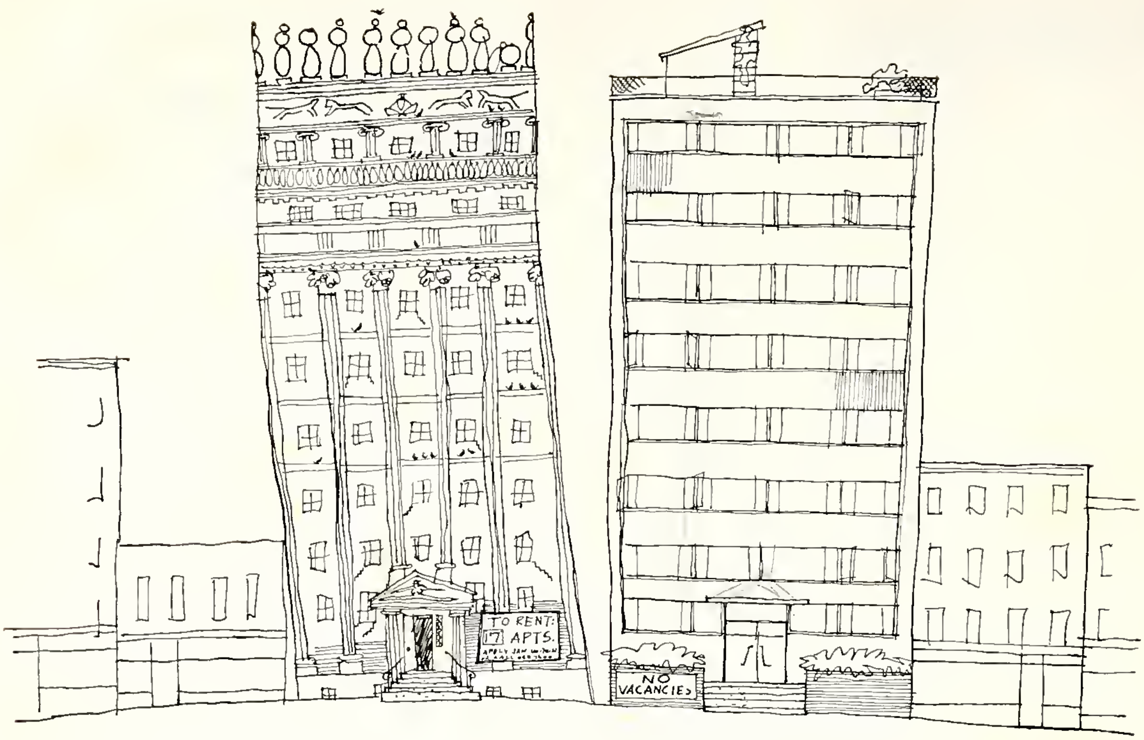


Fig. 1. Two approaches to the vacancy problem.

a brick wall a short distance away. The allure of gadgets frequently offered as a substitute for these things, such as fancy colored baths, red stripes on the kitchen cabinets, heavily textured walls, imitation fireplaces, and flashy lobbies will quickly fade (Fig. 2), and the success of the project is dependent on a rental appeal that is of lasting quality.

For many individuals and family groups the problem of shelter is not met by the single family house, and apartment buildings providing living and housekeeping facilities best meet the need. Apartments are living units arranged and equipped for housekeeping, grouped in one of many ways, varying in size, appointments and facilities, and providing a wide degree of flexibility to satisfy all requirements of urban and suburban living.

Practically every city in the country is a potential market for new rental units, as statistics show that there has been a steady increase in the number of apartment buildings over the past thirty years. According to a survey made by the Bureau of Labor Statistics, the year 1926 was the first year in which the construction of apartments exceeded that of single family dwellings in a representative group of 257 cities. In that year almost one-half of all the money spent on family dwelling units was expended on apartment houses. During the period from 1921–1927 the percentage of families housed in apartments almost doubled.

There was an increase in the number of rental units up to the beginning of the war. During the war period the percentage of home ownership increased, due probably to forced buying caused by the desperate shortage of living accommodations of any sort. This trend will undoubtedly reverse as building conditions change and more housing units become available. Recent surveys of the desires of war veterans, for instance, show an overwhelming majority who wish to rent quarters in preference to purchasing houses.

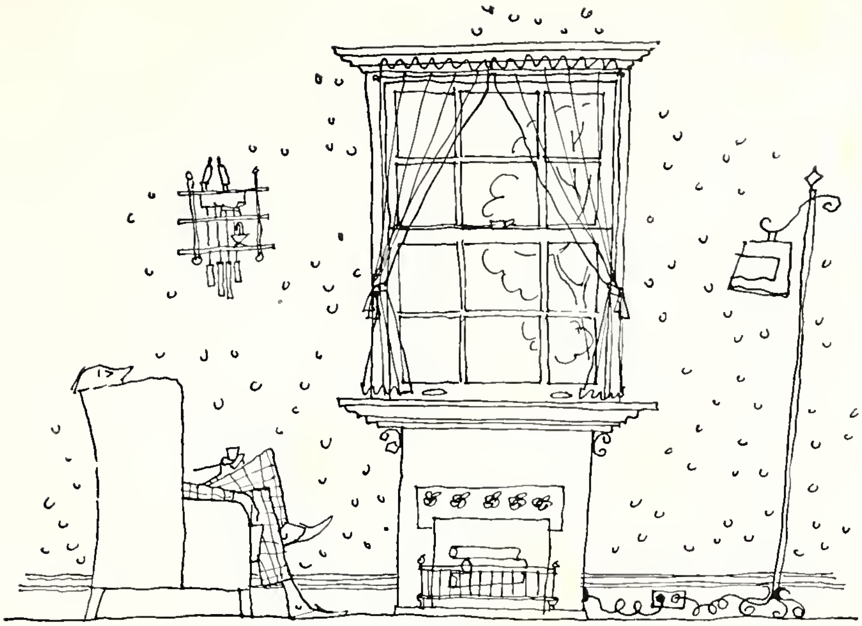


Fig. 2. Value of flashy imitation soon disappears.

The movement to apartment living is not confined to any one income group. The rich and the well-to-do have found there a partial answer to the servant problem, as the number of servants required for a sumptuous apartment is less than that needed for a large private house. There are in addition many other advantages in the form of superior services and facilities not to be found even in the most luxurious town-house. Those in more moderate circumstances have shown a growing tendency toward living in fewer rooms, the largest number of apartment units built in the past being of three rooms. There is a considerable demand at present for two bedroom units, which would seem to indicate a tendency toward apartment living on the part of larger family groups than has formerly been the case.

Probable reasons for the trend toward apartments may be found in increased living costs, high taxation, and in the changing pattern of living brought about by the influence of present day civilization.

Types of Occupancy

Efficiency units, so called, consisting of one room with kitchen, bathroom, dressing and storage space frequently provide an answer to the requirements of the young married couple, both of whom work or are away from home a large part of the time. If suitably located near places of work, such units also are adapted to the needs of unmarried individuals, two or three men or women joining together for the maintenance of living accommodations. Such units do not provide desirable standards of privacy or comfort, but are generally superior to the usual boarding house which is frequently the only alternative.

Housekeeping units of various types should be designed to provide as a minimum all the advantages found in the small house and at the other end of the scale a degree of amenity and luxury beyond the scope of any but the most expensive houses. Every unit should, so far as possible, be arranged for and contain sufficient space for fulfilling the primary functions of household life: entertaining, study, reading, relaxation,

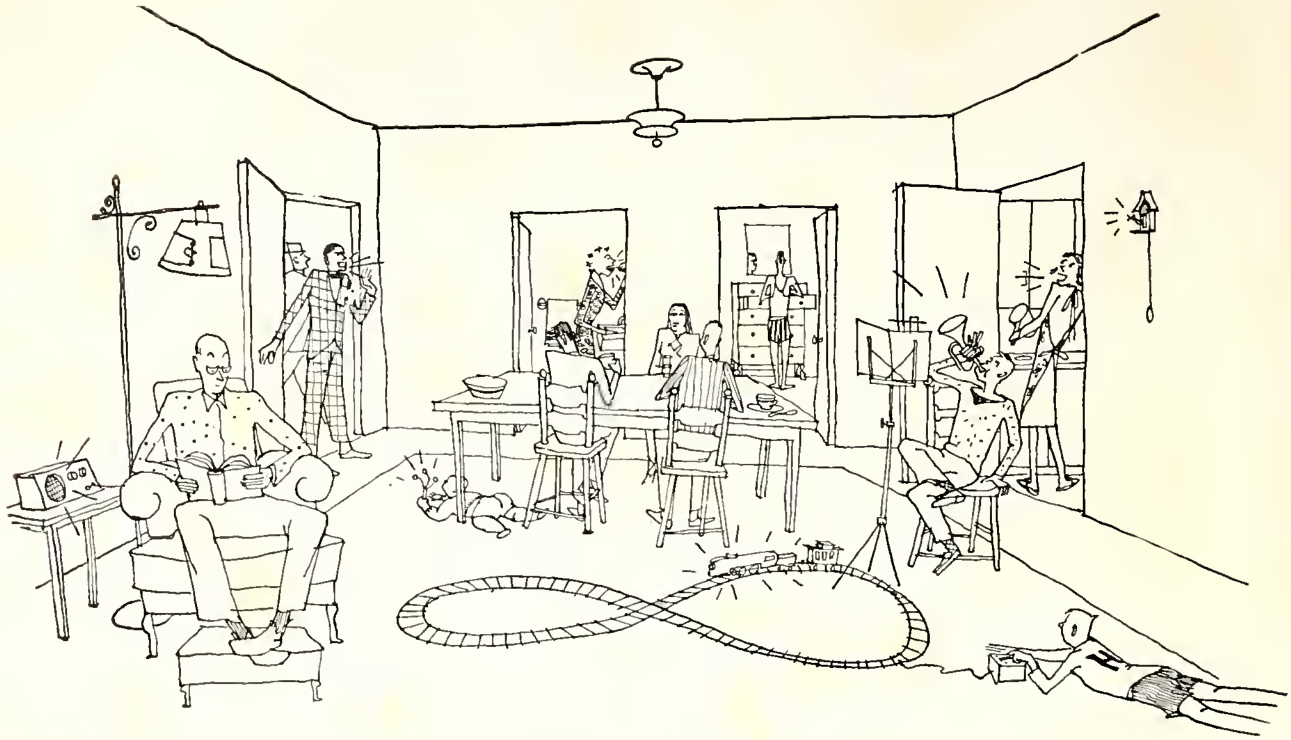


Fig. 3. Limited privacy

recreation, cooking, laundry, sewing and mending, eating, sleeping, personal hygiene, bathing, storage, and adequate circulation between these spaces. Attainment of desirable standards of privacy is very important and is frequently neglected (Fig. 3).

A wide variety of units must be included in a comprehensive scheme to accommodate the requirements of various income and age groups. The needs of one family may change several times during the course of a few years as family income and size vary. In attempting to satisfy these needs the amount that can be paid by the income group for whom the building is intended must be kept in mind, because the inclusion of facilities beyond the tenants' ability to pay will not result in a solution to the problem, but will merely result in shifting the occupancy of the building to a different income group than that for which it was intended. Family income data should be analyzed to predetermine the rents which may be obtained.

Apartment design has seen considerable change during the past years, as old customs, habits, and prejudices have given way to new modes of living. The dining room as a separate room has largely disappeared. Many rooms are now arranged for varied uses. Smaller families, outside business, employment of both husband and wife, increased dining out, sending out of laundry, the radio, movies and other entertainment, the automobile, child care in day nurseries and nursery schools, changing standards of hygiene, new methods of food and meal preparation, commercial housekeeping and maid services, and many other influences have wrought changes in people's living habits and should be reflected in their dwellings even more in the future than has been the case in the past. The apartment also adds to the mobility of those who need or desire to shift their dwelling place from time to time and enables them to avoid the financial ties which home ownership involves.

Buildings designed to fulfill these conditions will of necessity be quite different from

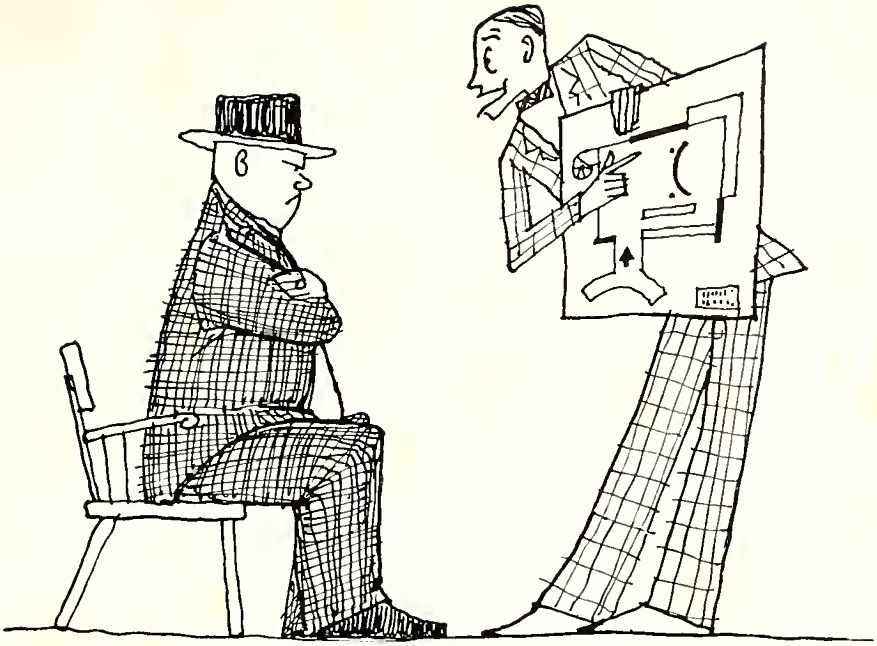


Fig. 4. The architect tries persuasion.

those which have been built in the past, but are sure to meet a ready public acceptance, as people are generally quick to realize their advantages. On the whole the public has been quicker to accept innovations in design than has the builder or the mortgage banker. This has not, however, always been the builder's or the banker's fault. They are both naturally conservative and tend to follow well worn paths. The old saying that "nothing is so timid as a million dollars" holds true here, but except in times of a great housing shortage, like the present, the public is in a position to demand better living quarters and when the market becomes competitive, it will get them.

Builders, like any other producers of commodities for sale, are only too eager to give the public what it wants but they are generally slow to believe that what the public wants is something different from what it has accepted in the past, for the public is not articulate.

Sometimes, too, the public is not aware of the possibilities; many tenants accept the type of living quarters offered with little thought as to whether or not anything different would be possible or desirable. It is only when they actually see new or different arrangements or facilities offered that they awaken to a realization of what good design can offer them. And here lies the architect's dilemma. He must somehow influence the builder toward better buildings, in order that the public may gain an insight into the possibilities and give expression to its preferences by patronizing the best buildings.

It is generally necessary for the architect to use all his persuasive powers to get the builder to incorporate advanced ideas in his designs (Fig. 4). This persuasive process is unfortunately slow and must be carried out over a period of years on successive buildings, as it is very rare to find a builder who will accept many new ideas at one

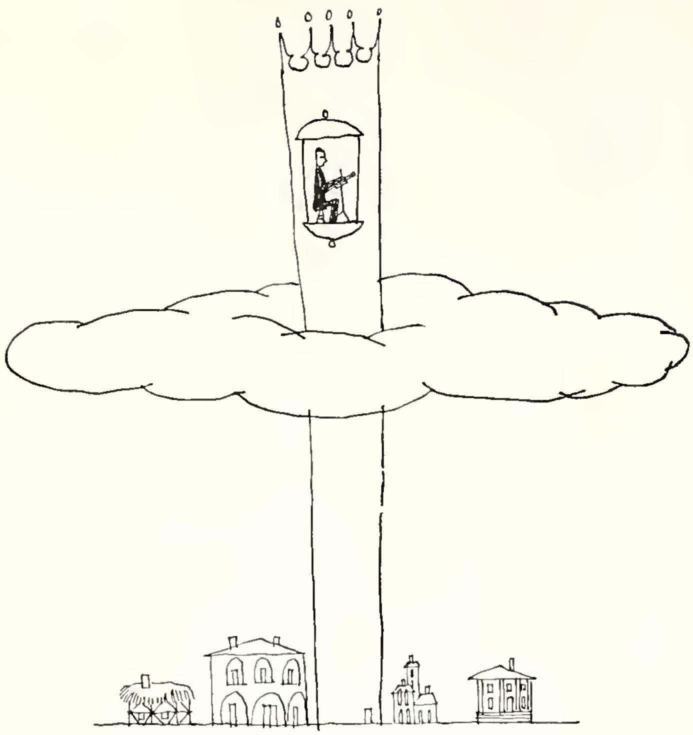


Fig. 5. Ivory tower psychology is passe.

time. However, once a builder has seen the ready public acceptance of good planning and design he is generally in a more receptive attitude on future jobs, and other builders are ready to follow the same trends. But this process also will compel the architect to plan many buildings which do not comply with all the standards which he, as architect, would wish to see incorporated in their design.

Some architects believe that any compromise with standards which they set up for their work is a betrayal of the cause of architecture, and they insist that any building which they design must conform to these standards. When confronted with an owner whose wishes in respect to a building do not conform to these standards, they have only two possible courses of action: to persuade the owner to their point of view or to throw up the job. Commendable as this attitude may be in some respects, I do not believe that it is the proper solution to the problem. If every effort to convince the owner of the rightness of the architect's viewpoint has failed, and unless the owner's demands are so unreasonable as to be impossible of fulfilment, it is far better for "the cause of architecture" for the architect to put forth his best efforts under the circumstances and accept the client's limitations as a part of the problem. Every good element he can get into a given building is a step in the right direction and with the exercise of a reasonable amount of judgment and persuasion both the builder and the tenant can be educated along the lines of better architecture.

An attitude of no compromise generally seems to the client merely arbitrary and stubborn, and on the part of the architect it is really a retreat from reality rather than an attempt to solve the problem (Fig. 5). The field of apartment house design has suffered greatly in the past from neglect on the part of architects, but a type of building which houses such a vast number of the total population of the entire country should certainly prove a problem worthy of their serious attention and study.

Types of Ownership

Apartment buildings may be owned in their entirety by individuals, corporations,

or government housing authorities and the units rented to individual tenants, or they may be of the cooperative type in which the units are occupied by the owners of the building.

Cooperative apartments were organized in New York City as early as 1870. One of the first elevator cooperative buildings in Chicago was organized in 1910, and is still occupied by some of the original owners. Most of the cooperatives in the United States have been built for occupants in the higher rental brackets, with a few outstanding exceptions. The building for the Amalgamated Clothing Workers in New York City and the Paul Dunbar Apartments in Harlem, New York City, have achieved notable success, which is attributed to the racial and economic solidarity of the groups involved. The cooperative project at Sunnyside, New York, achieved only moderate success due to a feeling on the part of the income groups involved that it was preferable to either rent or to own outright. Cooperatives have achieved great popularity in Europe. The Neubuhl project is an outstanding example. In Sweden, in particular, there are many successful cooperative buildings (Fig. 6). Their success is attributed to a public familiarity with cooperative methods and the existence of a central producers' building cooperative which has solved most of the problems involved in the organization of such projects.

The scheme has suffered from a bad reputation in the United States due to the manipulations of speculators during the late twenties. During this period the cooperative idea had developed rapidly, and was exploited to the full by unscrupulous real estate developers. Buildings were sold on the cooperative basis at such highly inflated prices that most purchasers had little, if any, actual equity in the building. During the depression the effect of this over financing was severe, failures of cooperative projects were widespread, and the scheme as a whole fell into discredit. The non-promotional schemes, however, weathered the depression and have had continued success.

Later efforts to revive the idea during the thirties proved fruitless, due to the bad reputation caused by the speculative boom, in spite of the examples of success provided by the non-promotional schemes and the notable success of such buildings in Europe.

The cooperative scheme has considerable merit when organized and operated by a proper group on a sound financial basis. The usual cooperative is formed by means of a corporation or trust holding the equity in the property, and stock is apportioned among the members in accordance with the appraised rental of the apartment to be occupied by the individual. The owners receive "proprietary leases" requiring payment monthly of charges for financing expenses, taxes, and operating costs involved. These leases are generally very long and complicated as they must cover all the contingencies of operation over a very long period of time. The purchaser must agree to pay the monthly charges mentioned above, and usually must agree not to sell his portion of the building, nor sublet it to another tenant, except with the consent of the board of managers of the corporation. The buildings are usually managed by a board of trustees or by a board of directors elected by the tenants, and the owner must agree to abide by their decisions in regard to policy of operation.

The principal advantages to be gained from cooperative ownership are a saving in living expense and the feeling that stock is a more liquid investment than an owner-

ship in fee. In addition, if the individual apartment is purchased before the building is built, the owner is able to make changes in the layout and equipment to suit his own desires.

The savings under cooperative management are derived from elimination of vacancies, saving of fees for rental commissions, and saving in maintenance costs. Usually maintenance costs are reduced because tenants take better care of their own property than they do of rented property. In addition any profit that would normally go to the landlord accrues to the tenant in the form of a saving in rent, and being a saving rather than the receipt of actual money, it is not subject to income tax. Permanent tenancy by the owner is thus the essence of the scheme, as some of these benefits are not obtained if the apartment is sublet to another tenant.[4]

If the problems of organization and finance, which have been the principal deterrents to a revival of this type of operation, are overcome by strong and wise group leadership the cooperative scheme has many advantages deserving of consideration, especially by already well organized groups such as labor unions, federal, state, or local government employees, or other groups with strong racial or economic bonds.

Urban and Suburban Building Types

From the standpoint of both the tenant and the builder, both urban and suburban sites have their own inherent advantages and disadvantages. The downtown apartment offers the tenant quick accessibility to places of work, shopping districts, and amusement centers, and sometimes the rather dubious advantage of a "swank" address, but this gain is usually at the expense of many amenities in the form of good light and air, outlook, and orientation; because under present land costs and zoning regulations such buildings are built on sites too crowded for these amenities to be provided. From the builder's viewpoint such density of building is found necessary to pay for high land costs and he feels justified in erecting on a given site all the units he is permitted by law to build. The percentage of operating profit on such urban buildings is generally higher than for buildings on suburban sites, as such locations usually carry a much higher rent than comparable units will bring in a suburban location.

The suburban site, on the other hand, can offer more in the way of light, air and view, and outdoor facilities such as playgrounds and garden space, usually with lower rentals, at the price of more time spent in traveling to and from work and shopping places. For the builder these sites have the advantage of lower land costs and usually lower building and maintenance costs, since the same standards of service as in downtown buildings are generally not offered.

The luxury-type apartment is sometimes encountered in suburban surroundings, and may possibly be found there more often in the future than has been the case in the past. This type of building offers the advantages of suburban surroundings combined with superior living accommodations for those who for various reasons do not wish to undertake the responsibility of maintaining a house. Facilities for golf, tennis, riding, and other sports may provide the conveniences of a country club, and restaurants and housekeeping services may be offered to eliminate the servant problem.

In many cities a desirable compromise may be found in sites not far from the heart of the city, offering many of the advantages of each type of site. Only slightly longer traveling time may bring one to a site which it is feasible to use at a density com-

parable to a suburban site and offering many of the advantages of light, air, and view found usually only in the suburbs.

Cost Limitations

As apartment buildings, aside from public housing, are built as a source of investment or speculation, the element of cost enters largely into their design. Advancing standards in construction, finish, and equipment add to the cost of the building and must be balanced against the rental that can be obtained in competition with neighboring buildings.

Construction standards for the main portions of the buildings are usually set up by state or city building codes and permit little variation so far as cost is concerned. Costs of sites usually vary with location and permitted density of occupancy and so will remain fairly constant for a given type of building in any particular locality. This leaves as the variable part of the design subject to control such items as room size, finish, equipment, and facilities to be provided.

An item of the utmost importance is the efficiency of the planning; clean uncluttered arrangements of rooms and units with elimination of waste space is a cost element within the architect's control that may well prove vital to the success of the project.

Cost elements must be balanced carefully against the estimated rentals to be obtained, keeping a careful eye on the possibility of future vacancies, as it will be found that units which are best in their respective price class will show much less turnover in the course of the years. This elimination of vacancies, so far as is possible, is a large element in the profitable operation of a building.

Some builders, having the intention of selling their building, attempt to build it as cheaply as possible in order to make a little more profit. However, the items on which it is possible to save in this manner are not numerous and are liable to prove a boomerang as changing conditions may cause the builder to keep the building for himself, and these same items may loom large as a maintenance factor. On the other hand, the investment builder may decide to sell and to do so must sell at a price in competition with the speculator. These considerations more or less balance and prevent there being much difference in these two types of operation.

It is the architect's problem to balance all these items and draw his plans so as to provide for the proper building in relation to its site and environment, with proper selection of unit sizes and types laid out in the most economical manner, and finished and equipped consistent with the scale of rentals to be obtained. It is also his problem to convince a sometimes reluctant builder that good design pays dividends in prompt rental, elimination of vacancies, and in lower maintenance costs.

It has been the general custom among owners to try to obtain the highest possible rents, and to base their financial setup on an income expectancy which is not realistic, as the real economic value is determined by net profits over a long period of years. Except in periods of inflation rents will decline as buildings become older, and financial arrangements which will permit low or moderate rentals will provide the greatest stability of investment.

Costs and Rentals

The problem of costs presents many complex features which must be considered in their proper relation to each other. The first element is capital cost, that is, the cost of land and its improvement, the cost of erecting the building, and other expenses incident to construction. These costs may be itemized as follows:

1. Site costs—

A. Cost of land.
B. Cost of utilities on site.
C. Extension of utilities to off-site mains.
D. Extra foundation work (such as may be caused by filled ground, rock, ground water, etc.).
E. Landscape work.

2. Construction costs—

A. Labor and materials.
B. Builder's fees and overhead.
C. Payroll taxes, (social security, unemployment, etc.).

3. Costs incidental to construction—

A. Architectural and engineering fees.
B. Interest on loan during construction.
C. Taxes on real estate during construction.
D. Insurance.
E. Financing expense, mortgage insurance premiums, examination fees, etc.
F. Title and recording expense.
G. Legal expenses.
H. Organization expenses.

The second element is the building income derived from rents. The elements composing rent may be itemized as follows:

1. Operation and maintenance—

A. Costs of fuel, electricity, elevator maintenance, exterminating, gas, payroll, phones, trash removal, water, repairs, decorating, renting and administration, insurance, taxes, miscellaneous small items.
B. Allowance for vacancies.

2. Financial expense—

A. Interest.
B. Depreciation reserves.
C. Maintenance reserves.

3. Profit and income taxes—

The first element, capital cost, is reflected in the second element as financial expense. This item is affected by variations in the interest rate, and by the amount of equity and mortgage. The sum of the equity and mortgage is the capital cost.

Interest rates are relatively stable. For example, in the early nineteen hundreds they were about 4%, during the course of the years they slowly rose to about 6%, and in the late thirties they dropped again to around 4%. Building costs on the other hand fluctuate violently. In addition to this fluctuation, building costs tend to rise with higher standards of housing design and increasingly rigid requirements of building and zoning codes. Cost of land is largely determined by permitted population density, and as standards grow stricter in their requirements land cost per unit increases. Installation of mechanical equipment on an increasing scale also adds to cost. Such equipment now runs about 25% of the total building cost and has a trend towards increasing.

An analysis of total capital costs will show that no one element of cost is large enough to be a determining factor in itself. The only chance for any sizable reduction in total cost is from an accumulation of many small savings on all of the items involved. There are several approaches to the problem:

Design-Economy can be obtained by elimination of wasteful building shapes and by the omission of superfluous ornamental features. Good design achieves compactness by elimination of superfluous space, by planning rooms so that they may be combined or used for several purposes, and by providing proper storage space. Good engineering design aims at eliminating unnecessary dead weight, avoiding complicated structural layouts, and by research develops new formulas and design methods which help achieve this aim. Proper design of mechanical installations and research into heating, electrical, and plumbing requirements also have possibilities for economy.

New materials. Research promises new lighter materials, such as panels for exterior and interior walls, salvageable materials which can achieve economy through their reuse, and more durable materials which offer economy through a reduction in maintenance costs. Along with these new materials is needed a revision of building codes to permit their use.

New assembly methods. Use of dry materials offers the chance of important savings and such materials will no doubt soon be developed. Their use will result in the elimination of enormous quantities of water from the building and will speed up construction time. The elimination of wood in wet type construction will also result in economy, through saving of time and lower maintenance costs. The integration of equipment and development of off-site construction and assembly of parts will lower labor costs.

Finance. The influence of financial costs is often exaggerated. Decreasing of interest rates by 1% will permit a lowering of rents by about $1.00 per room per month, and a reduction in capital costs of $100 will permit a lowering of rents by about 60¢ per room per month. These figures are only approximations, of course, as they are interdependent, but they serve to give a rough idea of the magnitude of the amounts involved in rent reduction. As an example, assume a building with a per room cost of $1,500, in which rents are set at $15.00 per room with an interest rate of 4% on the entire cost. The amount of interest per room per month on this basis is:

$$\frac{1{,}500 \times .04}{12} = \$5.00$$

If the interest rate is then lowered to 2% the amount is then:

$$\frac{1{,}500 \times .02}{12} = \$2.50$$

a reduction of $2.50 per room per month, which reduces the rent from $15.00 to $12.50. Thus in this case a reduction of 50% in the interest rate gives a reduction in rent of less than 17%. As an example of the effect of cost reduction, take the same conditions as above and assume an interest rate of 4% and an amortization rate of 3%. The portion of rent directly attributable to financial costs is then:

$$\frac{1{,}500 \times .07}{12} = \$8.75$$

If the per room cost is lowered by $200 the amount for financial costs is then:

$$\frac{1{,}300 \times .07}{12} = \$7.66$$

This is a reduction of $1.09 per room per month, which reduces the rent to $13.91. Thus in this case a reduction in capital cost of a little over 13% results in a rent reduction of about 7%.

Savings in cost gained by the omission of standard parts, equipment, or finishes, or by the shifting of maintenance costs onto the tenants cannot be called a solution to the problem of lowering construction costs. A country with the resources in manufacturing capacity, raw materials, and with the trained manpower that this country has should not need to return to primitive conditions for its shelter.

The gross incomes of buildings, their operating costs, and the profits made from their operation vary with differences in location, quality of space offered, services rendered, rental groups served, mortgage status, and the size of the project. The designer must know costs thoroughly in order to be able to choose intelligently in regard to the great range of variations in all the elements within his control, and must bear in mind that a low first cost does not always produce the lowest rentals.

Many owners have been forced to expend large sums for replacement of improper and obsolete equipment, for installation of items which are demanded by improving standards of living, and for general maintenance of poorly constructed and finished buildings.

The building industry as a whole is greatly hampered by a lack of reliable statistical information. Satisfactory information on such subjects as rents, occupancy, vacancy, operating expenses, construction costs, and population data is not available. Research into basic housing standards has not progressed nearly as far as it should have, and most standards in use today are based on opinions rather than on supported facts.

A good example of this lack of information is the variations in the present estimates of the country's need for housing. Opinions on this subject vary tremendously, all the way from 1,200,000 dwelling units per year for the next ten years down to about half that number. Opinion also varies on how many of the needed units should be rental units and how many should be for owner occupancy.

The collection, interpretation, and publication of reliable statistics on such subjects would be a worthwhile project and would benefit the whole public, as well as all those concerned with the building industry.

Investment Buildings

It is a fair assumption to make that most existing apartment buildings were built for speculation rather than as an investment, and every depression has seen a wave of foreclosures of rental properties due to bad financial arrangements and unsound management. That investment in such buildings can be both safe and profitable is

well illustrated by the example of the City and Suburban Homes Company,[1] one of the oldest limited dividend companies in the United States.

This company has paid an average annual dividend of 4.2% on its capital stock since 1898. During this time it has increased the amount of capital stock outstanding from $489,000 to $4,255,690 and has increased its surplus from nothing to $1,232,000 in 1938. The company has been a leader in experimentation in housing and apartment buildings, it has had low rates of vacancies, averaging less than 4% throughout its entire history, and low rates of depreciation and obsolescence.

Due to the semi-philanthropic nature of the company and its desire to provide good living accommodations for low income groups, it has maintained a rental scale in the lower 20% of the range for New York City, and its rents have been below $10 per room per month on an average.

Good management maintains a fair return on the investment in property, accumulates surplus and depreciation reserves, and by maintaining the property in good condition it avoids losses due to vacancies. The old policy of obtaining as large a mortgage as possible, and sometimes two or three mortgages, drawing out of the building every cent of available cash, and then allowing the property to be foreclosed, as was frequently done in past years, is not good business in the long run for any one concerned.

For proper stability of investment the correct type of mortgage financing is very important. The old type of straight mortgage loan (a loan for a comparatively short period of time with no provisions for amortization) has practically disappeared. Two types of mortgages are in use at the present time, straight line amortization loans, and constant payment mortgages.

In the first type a fixed amount is paid each year as amortization plus interest on the unpaid balance. This results in a lower payment each year as the amount of interest becomes less and less. The second type maintains a fixed payment each year, the proportion of the amount credited to amortization gradually increasing, as the amount allocated to interest is reduced.

Due to the fact that the straight mortgage is made for very short periods of time, and must be renewed or paid off at the end of every such period, the borrower is at the mercy of the financial institution if the due date comes during a period of depression or financial stringency. Most of the trouble into which apartment buildings fell during the last depression was from this cause.

With the other two types of mortgage much higher loans can be made with greater safety to both the lender and borrower, because the amount of the loan is continually being reduced, and the borrower's equity in the building is increased, providing of course that the amount of amortization exceeds the amount of depreciation. There is a tendency for owners to look on all amortization as an increase in equity, but this is not the fact; the real increase in equity is the difference between the amount paid for amortization and the amount of depreciation.

[1] Four Decades of Housing with a Limited Dividend Corporation, FHA Form No. 2208, FHA, Division of Economics and Statistics, Superintendent of Documents, GPO.

TABLE 1. ELEVATOR BUILDINGS IN WASHINGTON, D.C.—OPERATING DATA

Building	No. Apts.	No. Rooms	Per Room per Month			Expenses as Percent
Total	519	1198	Rent	Expenses	Net Income	of Gross
A	128	282	27.48	10.92	16.56	39.73
B	125	251	24.56	9.44	15.12	38.43
C	95	269	31.59	10.17	21.42	32.19
D	126	268	28.91	9.54	19.37	32.99
E	45	128	25.06	7.88	17.18	31.44
Average	103.8	239.8	29.52	9.59	17.93	34.95
F	61.4[1]	168.5[1]	22.84	10.13	12.71	44.40
G	75.8[2]	226.9[2]	18.17	8.19	9.98	45.10
H	185	533	18.41	10.85	7.56	58.90
K	161	487	22.14	12.69	9.45	42.68
L	235	699	17.64	9.08	8.56	51.47
Average	193.6	573	19.39	10.87	8.52	51.01

Buildings A to E are eight story buildings, 5 to 8 years old. Figures given are for 1945.
Buildings H, K, and L are four and five story buildings, 15 to 18 years old. Figures given are for 1945.
Items F and G are taken from "A Survey of Apartment Dwelling Operating Experience in Large American Cities," FHA, 1940. Figures given are for year 1935.
[1] Based on 12 reports, for buildings in the rental range of $20.00–$29.00, 2,022 rooms, 737 apartment units.
[2] Based on average of all reports, 9,077 rooms, 3,031 apartment units, 40 reports, for buildings in the rental range of $5.00 to $50.00.
Depreciation and financial expense have not been deducted from net income, or added to expense.

A choice between the second two types of mortgages depends on financial conditions at the time the loan is made, and the owner's estimate of the probable trends in rent in the future. Authorities are not in agreement as to which type is the better. The straight line amortization type requires higher payments at the start of the operation, these payments being gradually lowered as the loan is reduced. This results in a heavier initial burden of payment, a lighter burden when the building is older, and also permits a higher return on the owner's equity if rental income is maintained at a level higher than the amount of decrease in payment. The constant payment type has a lower amount of payment required during the early years of the project, but a heavier burden later when rents may decline due to the age of the buildings, changes in the desirability of the neighborhood, or other conditions.

Another condition which should be noted is that if the loan is an insured one, the insurance does not cover loss to the lender between any cessation of payments and the time of foreclosure. In times of stress, therefore, the lender, in order to protect himself from loss, is liable to institute foreclosure proceedings immediately rather than to carry the building for a time, until other arrangements can be made, as is frequently done when mortgage insurance is not a factor.

Operating and Maintenance Costs

The problem of operating and maintenance cost is one of the many subjects on which very little reliable data are available in published form. Differences in accounting methods make the interpretation and comparison of the little that are available both difficult and inaccurate.

Tables 1, 2, 3, and 4 show a comparison of data on a few buildings in the Washington, D.C., area which I have collected and which are presented here for whatever they may be worth. Items F and G, in Table 1, and items X and Y, in Table 2, are taken from *A Survey of Apartment Dwelling Operating Experience in Large American Cities*.

TABLE 2. WALK-UP BUILDINGS IN WASHINGTON, D.C.—OPERATING DATA

Building	No. Apts.	No. Rooms	Per Room per Month			Expenses as Percent
Total	147	408	Rent	Expenses	Net Income	of Rent
M	75	205	20.80	7.86	12.94	38.98
N	44	132	23.45	7.45	16.00	31.76
O	28	71	26.47	7.31	19.16	27.61
Average	49	136	23.57	7.54	16.03	32.78
R	591	2290	15.38	5.42	9.96	35.24
X	38	61	21.45	11.00	10.45	51.30
Y	25.2	74.6	13.53	6.10	7.43	45.10

Depreciation and financial expenses have not been deducted from net income, or added to expense.
Items X and Y are taken from a "Survey of Apartment Dwelling Operating Experience in Large American Cities," FHA, 1940. Figures are for 1935. Item X is based on two reports for buildings in the rental range of $20.00–$29.99. Item Y is based on the average of all reports for walk-up buildings, 32 reports, 805 apartment units, 2388 rooms. Rental range $5.00–$50.00.
Figures for buildings M, N, O and R are for 1945.

FHA, 1940. These figures are for the year 1935. As presented in the above book, figures were per room per year; as presented here they have been divided by twelve for comparison with the other items given, which I preferred to present on a monthly basis.

The FHA survey presented figures for seven cities: New York, N.Y.; Washington, D.C.; Chicago, Ill.; St. Louis, Mo.; Kansas City, Mo.; San Francisco and Los Angeles, Calif. The figures presented here are for the Washington. D.C., area only, and a comparison of buildings is given in similar rental ranges to those in items A to E and M to Q, as well as the averages for all reports received for buildings in this area. Figures for buildings A to E, H, K, L, M, N, O, and R, are for the year 1945.

Another item, which has not been incorporated in the tables, but which is of some interest for purposes of comparison, are the averages of eight Manhattan projects of the City and Suburban Homes Co.[1] The total expenses of these projects, not including financial expenses and depreciation, varied from a low in 1910 of $31.38 per room per year, to a high in 1936 of $72.54 per year.

In order to draw any conclusions from these tables, some descriptions of the buildings involved are required. Buildings A to E (Table 1) are all corridor type buildings, mechanically ventilated. Building A contains several stores whose income has not been included in the table. The expenses incident to operation of these stores has, however, been included, as it was not possible to segregate them. This factor accounts for the increased amount of electricity used by this building, as the stores are air conditioned, an element of equipment which uses a large amount of current. Buildings A, B, and D contain mostly efficiency units, while buildings C and E are made up of housekeeping units.

[1] Four Decades of Housing with a Limited Dividend Corporation, FHA Form No. 2208.

TABLE 3. DETAILED BREAKDOWN OF EXPENSE ITEMS—ELEVATOR BUILDINGS

All items of expense are given per room per month.
All figures are for 1945

	Eight Story Bldgs.						Four and Five Story Bldgs.			
Building	A	B	C	D	E	Avge.	H	K	L	Avge.
Number Employees	7	6	7	9	2	6.2	17	20	9	15.3
Fuel	.85	.96	.80	.72	.80	.82	1.10	1.10	1.23	1.14
Electricity	1.49	.98	.98	.85	.89	1.03	.94	1.26	.50	.90
Elevator Main.	.20	.25	.24	.22	.31	.24	.16	.11	.19	.15
Exterminating	.04	.02	.02	.04	.04	.03	.04	.04	.02	.03
Gas	.30	.32	.46	.24	.25	.31	.....	.....	....	.....
Payroll	2.63	2.91	3.29	3.18	.99	2.59	4.03	5.05	2.27	3.78
Phones	.....	.16	.29	.12	.04	.12	.46	.56	.02	.35
Trash Removal	.11	.06	.07	.14	.22	.12	.07	.10	.09	.08
Water	.55	.21	.30	.17	.31	.31	.25	.21	.23	.23
Repairs	.59	.79	.08	.15	.79	.48	.46	.46	.73	.55
Decorating	.09	.23	.59	.88	.47	.39	.05	.04	.14	.07
Mscl.[1]	1.51	1.31	1.31	1.54	1.26	1.38	.98	1.30	1.50	1.26
Taxes	2.56	1.24	1.76	1.59	1.51	1.73	2.31	2.46	2.16	2.31
Total Expense	10.92	9.44	10.17	9.54	7.88	9.59	10.85	12.69	9.08	10.54

[1] Expenses covered under miscellaneous include renting and administrative costs, insurance, etc.

The major difference to be seen in the detailed breakdown of expense items (Table 3) is in the item of payroll expense. This is due to the difference in the character of service offered; buildings A to D. have resident managers, hall boys, and telephone operators; their staffs consist of from 6 to 9 persons, while building E employs only a janitor and relief man; elevator operation is fully automatic. This increased service is reflected in general in the amount of rent received as well as in expense, the rent in building E being lower than any of the others with the exception of building B. The lower rent of building B is due to the fact that the apartments are less desirable than those in the other buildings due to smaller room sizes and a less desirable location.

Buildings A to E are eight stories high, varying in age from about 5 to 8 years. They are well located for the class of tenants served, and are all of modern design. Losses from vacancies and bad debts in this group have been practically zero, and their attractiveness is demonstrated by the fairly high rentals which they have been able to maintain.

Buildings H, K, and L (Table 1) are four and five story elevator buildings ranging in age from 15 to 18 years. They are also well located, on a prominent street, with good general neighborhood characteristics, and they present a splendid example of wasted opportunities, poor design, and unsound management.

In building H, electricity is paid for by the building but gas is paid for individually by each tenant. The building is heated with a steam heating plant of poor design, which results in high heating costs and discomfort for the occupants. The building is only four stories high, with the result that for the number of units obtained it covers excessive ground area, has long involved corridors, and poor orientation for a great number of units. Elevators are located at widespread intervals and require the services of an excessive number of operators. The entire sprawling mass of building is covered with a high slate roof, which, combined with the use of a very dark red brick for all the walls, results in an unpleasant and depressing atmosphere.

TABLE 4. DETAILED BREAKDOWN OF EXPENSE ITEMS—WALK-UP BUILDINGS

All items of expense are given per room per month
All figures are for 1945

Building	M	N	O	Avge.	R
Number Employees	3	1	2	2	26
Fuel	.91	2.66[2]	.71	.81	.61
Electricity	.70	.57	.70	.66	.56
Elevator Main.	....	....	...	....	....
Exterminating	.05	....	.05	.05	.02
Gas	.58	[2]	.59	.58	.34
Payroll	1.17	.49	1.04	.90	.92
Phones	.06	....	.10	.08	....
Trash Removal	.12	....	....	.12	.002
Water	.29	.27	.17	.24	.16
Repairs	.47	.36	.56	.46	.21
Decorating	.48	.42	.26	.46	.55
Mscl.[1]	1.56	1.23	1.63	1.42	1.00
Taxes	1.47	1.45	1.50	1.47	1.05
Total Expense	7.86	7.45	7.31	7.54	5.42

[1] Expenses covered under miscellaneous include renting and administrative costs, insurance, etc.
[2] This group of buildings have individual gas heaters, gas refrigerators, and gas ranges. Separate costs for these items were not available. This figure was omitted from the average heating costs as it is not on a comparable basis to the other buildings.

The staff of employees required for operation is out of all proportion to the number of units involved and results in excessively high operating costs. In addition, the rentals obtained are low, considering location and the type of units offered, resulting in a very high ratio of operating cost to income.

In a building of this type, money expended for automatic elevator operation controls and a complete redesign and overhauling of the heating plant, would pay big dividends in the way of reduced labor costs and fuel bills. If this building had been designed to take proper advantage of the available site, it's income and operating costs over the past years would have been very different.

An eight story building on this site would have resulted in much lower ground coverage, more efficient use of elevators, and the elimination of great lengths of unnecessary corridor. In addition, construction costs per unit would have been lower, and losses from vacancies would have been much less. The rental scale of the existing building is considerably lower than those of other buildings in the vicinity. Due to the generally undesirable appearance of the exterior and the interior of the building, this reduction has been necessary in order to keep the building rented.

Building K is very similar in all respects to building H.

Building L is a group of four buildings, five stories high. There are four separate heating plants, one for each building. The heating system is an outmoded type of steam heat with inadequate controls. The result is reflected in its excessive fuel costs. Separation into four buildings results in inefficient use of elevators and unnecessary corridor length. Apartment units are poorly planned and inadequately equipped, a fact reflected in the low rentals. Rentals for this building are about 40% below the general level of neighboring buildings. The exterior design is mediocre and unattractive and the grounds are poorly landscaped. The buildings have automatic elevators of antiquated design, which should be modernized. The building does not furnish either electricity or gas to tenants, and has old-fashioned electric ice

boxes, operated from a central plant. This type of operation is expensive and hazardous. Replacement of antiquated equipment, redecoration of apartment units, and redesign of the heating system would pay big dividends.

Buildings H, K, and L do not have incinerators, a factor which also adds to the labor costs and results in unsanitary conditions in the buildings, where garbage is kept awaiting disposal. This whole group of buildings shows very conclusively the bad effects of poor design and unsound operating policies on profits. The failure on the part of the management to replace obsolete equipment and to keep the apartments decorated and fresh looking has resulted in a sharp decline in rental value and an enormous loss of revenue over a period of years.

Buildings M, N, and O (Table 2) are walk-up buildings. Building M consists of a group of three separate three-story buildings, each building having its own heating plant; the only services rendered are ordinary janitor service and cleaning and maintenance of public spaces. Building N consists of a group of two story apartments, each unit has an individual gas heater, gas refrigerator, and gas range. The fuel cost of all these items has in this case been entered under "Fuel" as it was not possible to allocate these costs to their respective equipment. Due to this fact the fuel cost for building N has not been included in the average heating cost, as it is not a comparable item. In building N there is no public space, all stairs and halls being included within the respective apartments, and placed under the care of the tenants. The only service furnished consists of ground and lawn maintenance and snow removal in the winter. Building O is a three story walk-up building with a central heating plant. Its staff consists of a resident manager and a janitor.

Building R (Table 2) is a good example of a large suburban project. This project consists of a group of 37 buildings. The buildings are of the grouped type plan, with apartments entered directly from the stair halls and no public corridors. They have large windows with steel sash, and are heated with four central heating plants. Large heating plants and an efficiently designed and controlled system result in a low fuel cost.

Opportunities for efficient management presented by a large project have been taken advantage of with the result that total operating costs per room per month have been kept low, and the ratio of expense to rental income is fairly low even with a comparatively low rental scale. These buildings are well maintained and fairly attractive in design, a factor which is reflected in a substantial and steady operating profit, combined with a moderate rental scale.

Although no positive conclusions can be drawn from such a small sample of building experience, several interesting conclusions are suggested that are well worth further investigation. One, that important savings can be made in operating cost by increased use of mechanical equipment and the elimination of elevator operators and telephone operators. Two, the cost of operating elevator buildings is no more than the cost of operating walk-up buildings, provided that the same degree of service is provided in each type. Three, the types and sizes of windows are not a determining factor in heating cost. Buildings A, C, K, and M have stock type wood double hung windows. The other buildings have lightweight, residence type steel casement windows, and the average window area per room in these buildings is much larger than in buildings A, C, K, and M. The average heating cost for buildings A, C, and

M is \$.85, and for buildings B, D, E, and O it is \$.80, not a significant difference. Building O, which has the lowest heating cost of the group, has the largest window area and approximately half of its windows face north and half face south.

It has not been possible to make an analysis of these buildings with respect to net profits, as financial charges vary too much, according to mortgage status, equity in the building on the owner's part, depreciation allowances, and surplus reserves for operation contingencies. Such an analysis would require statistical information over a long period of years, and this sort of information was not available.

It should also be noted that in the buildings whose income is given for 1945 there is no loss from vacancies, as all buildings were 100% rented. The 1935 figures probably reflect some loss from vacancies but data on this subject are not given in the report. The average vacancy in the Washington, D.C., area for those years was in the neighborhood of 7%. This factor, coupled with the fact that average rents in 1935 were lower than in 1945, makes the expenses for that year as a percent of gross income higher than the percent for 1945. The FHA study of apartment operating costs previously referred to indicates:

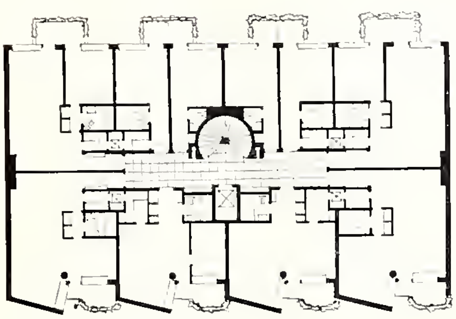
1. That the factor of operating expense remains fairly constant during periods of declining income.

2. That high rent buildings have normally a higher rate of profit than moderate rent buildings, but that the high rents are more subject to decline during a period of falling prices.

3. That costs for repair and maintenance tend to rise with the age of the building.

4. That real estate taxes are a stable and large item of expense. The fact that they are applied on an *ad valorem* basis causes them to bear little relation to net income, and they vary considerably between different cities.

5. That over a long period of years moderate rent buildings are the most stable and provide the soundest and safest investment.



TYPICAL FLOOR PLAN

Fig. 6. Kollektivhuset, Apartment house in Stockholm, Sweden. Sven Markelius, architect. A cooperative apartment house of distinguished design erected by a Tenant's Cooperative Building Society. The building contains a restaurant which will deliver complete meals to the apartment units; all housework, laundering, etc., is done by the building staff. There is a complete children's department where children play and study under trained supervision and where they may sleep if occasion demands it. The street facade was developed to shield the apartments and balconies from neighboring buildings and to give a view of Lake Malaren. Progressive Architecture.

Photograph by Courtesy of American-Swedish News Exchange

CHAPTER 2: The Site

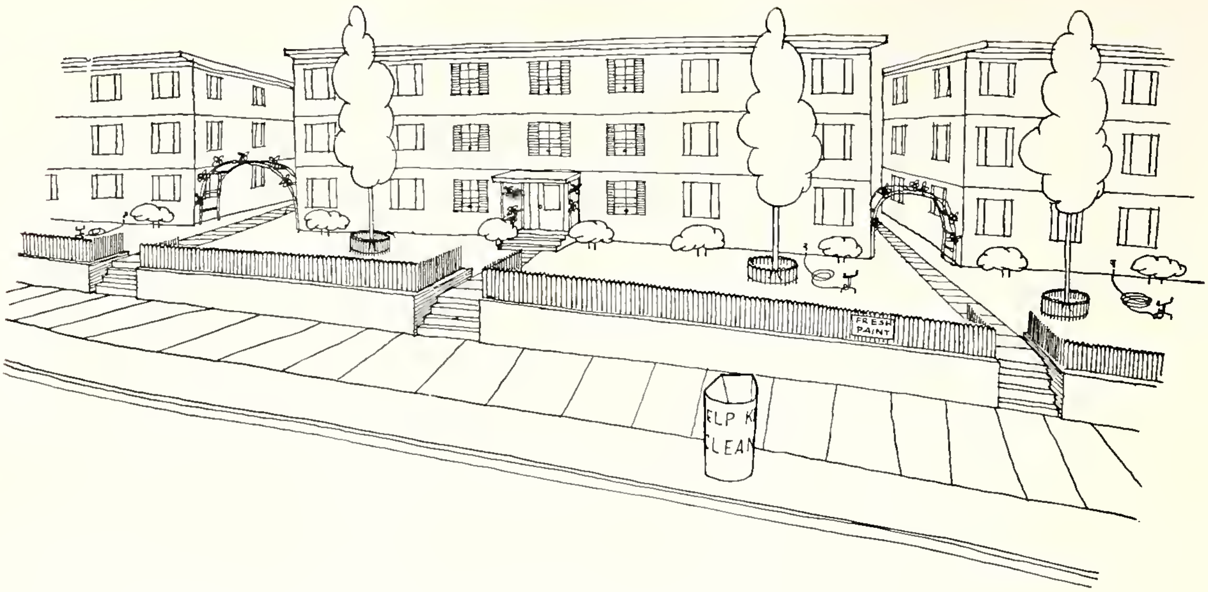


Fig. 7. Preservation of good neighborhood standards versus neglect and despair (Fig. 8).

LOCATION

Neighborhood Conditions

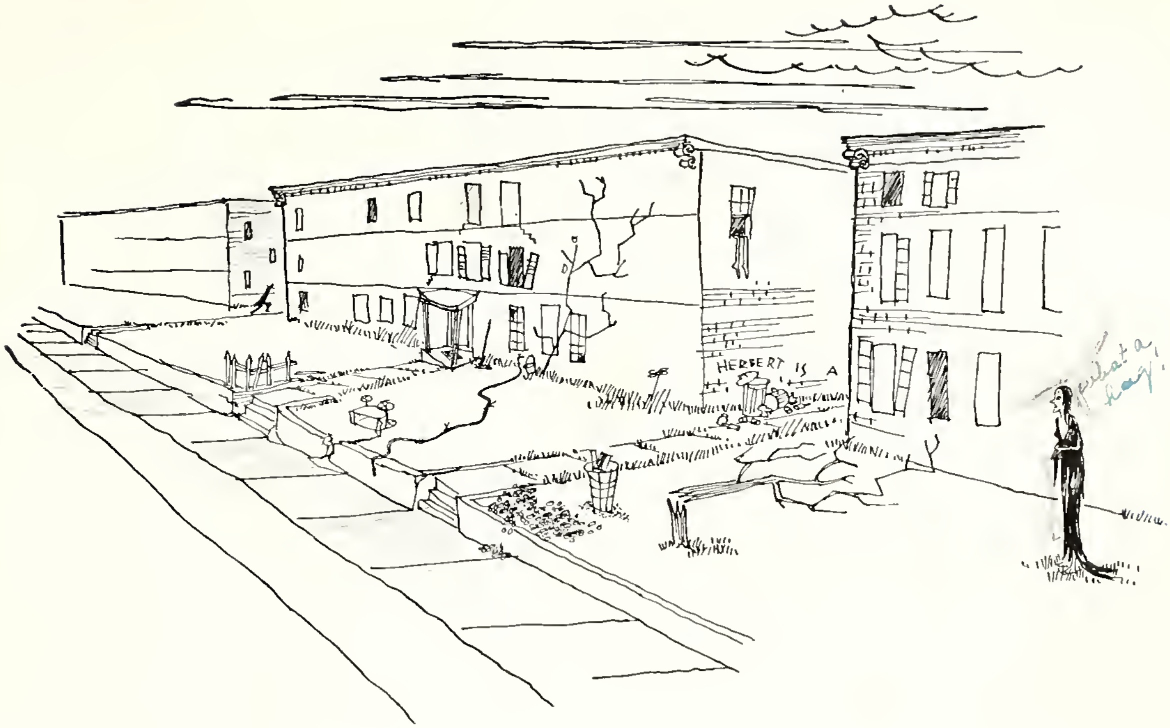
Neighboring buildings usually set the pattern of future development, except in sections which are being redeveloped or are undergoing a shift of character, and so predetermine to a large extent the type of building appropriate for any given site. Investigation of existing buildings and any possible trends toward neighborhood changes is of prime importance. The sizes of units in existing buildings, the income groups of their tenants, and the actual rentals received are all elements which affect the suitability of the neighborhood and determine to a large extent the corresponding factors in the building under consideration.

Very often the general appearance of neighboring buildings will give a good indication of stability or its lack. When buildings and grounds are well maintained, clean and neat, it is an indication that the owners and occupants of the buildings are taking an active interest in the preservation of neighborhood standards (Fig. 7). On the other hand, when yards and planting are ill-kept and untidy, and buildings show signs of neglect and disrepair, it is a sign that the neighborhood is on the downward path toward a condition of blight (Fig. 8).

In general, a new building which differs too widely from the neighborhood pattern is bound for hard sledding, and these conditions should be carefully considered when formulating plans. There are of course times when blighted neighborhoods are in process of development towards a higher standard of use. At such times, if the trends are firmly enough established, the proposed project should of course be in conformity with the upward trend.

Zoning Laws

As zoning laws usually determine the area and height of the building, and sometimes the population density as well, their requirements must be carefully checked before proceeding further. Regulations affecting land use should also be checked,



because it may be found that the possibilities of encroachment by commercial or industrial uses will have an adverse effect on the desirability of the property.

In addition to checking these factors for the site itself, the zoning regulations for adjoining neighborhoods should also be checked, and considered in the light of their possible effect on the site. Undesirable conditions in adjoining neighborhoods may well have a widespread effect.

Possibilities of future changes in zoning may be discovered, and may disclose factors of importance to the stability or desirability of the property.

Neighborhood Stability

As an apartment building is a long term venture the stability of the neighborhood is of prime importance. Indications of stability, or its lack, may be found by checking the financial success of similar buildings in the locality. The record of vacancies, mortgage foreclosures, and trend of rentals either to increase or decrease in nearby buildings is also a valuable indication.

Deed Restrictions

The deed to the property must also be investigated to determine whether or not it contains any provisions or restrictions relative to the type of building it is desired to erect, as some deeds will be found to contain restrictions as to type of building and set-backs required.

Zoning laws and deed restrictions will sometimes be found to vary in their requirements, in which case the one being the most stringent must be complied with.

It is usually useful to know whether or not any restrictions found in the deed are uniformly applied throughout the neighborhood, and the extent to which they have

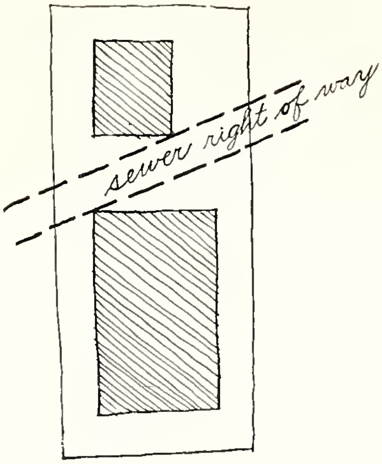


Fig. 9. Limited use of site caused by easement.

Fig. 10. Diagram of a good location for an apartment house.

been enforced. These factors may have considerable effect on the enforcement of restrictions against the site being considered.

At times deeds contain provisions for easements and rights of way which may have an important bearing on the layout of the building on the site or on its construction. For instance, lots may be found to have sewers or water mains across them, which have to be bridged over or left accessible. At other times it may be found that portions of a site cannot be built upon at all, as a right of way or easement may call for certain portions of the property to remain unobstructed (Fig. 9).

Certain property owners will be found who make it a condition of the sale that they shall have the right to approve the plans of any building erected on the site. They may own other buildings or property in the neighborhood, and feel that by enforcing this requirement they are protecting the stability of the neighborhood. In the event that a clause of this type is found in the deed, their requirements should be carefully investigated beforehand to see that they are not out of line with the type of building that it is desired to erect.

Information given the architect by the client on these matters is frequently inaccurate and should always be verified by the architect by consulting with the zoning authorities as to their requirements for the site in question. Deed restrictions may be checked either from the actual document or by consulting a title company which is familiar with the property in question. By taking these precautions the architect will, in the long run, avoid much trouble which may be caused by basing a scheme on prospects that cannot be realized because of restrictions that were not known at the inception of the project.

Accessibility

The availability of public transportation lines is a matter of great importance. For

transportation facilities to be considered adequate, the walking time from the proposed building to stations or stops should not exceed ten minutes, and the fares to usual points of destination should be reasonable. The frequency, speed, and general adequacy of the service furnished should be satisfactory for the class of tenancy expected. In general, traveling time to usual work places, shopping districts, etc., should not exceed one-half hour.

In some buildings, especially in downtown locations, the availability of taxi service and the fares to various points may be of importance.

Convenience of access and availability of parking space for private cars is an important feature. For suburban projects in particular, the capacity and type of public highways serving the project should be investigated, as well as the amount of traffic they carry. Overcrowded conditions or inadequate roads may make traveling time overlong during rush hours, even though the actual distance may be short.

Neighborhood Facilities

The adequacy of neighborhood facilities is an important consideration. The time required to reach them by walking, by means of public transportation lines, and by private car should be within reasonable limits for each type of facility.

Shopping districts, theaters, playgrounds, and churches should be within one-half mile of the building entrance. A grade school should be within one-half mile unless school bus service is available. Junior and Senior High schools should be within one mile (Fig. 10). Traveling time to hospitals and clinics should not exceed one-half hour by public transportation lines.

The number, kind, and accessibility of commercial centers, shopping districts, theaters, schools, and churches, have a considerable influence on the stability and desirability of the site from a rental standpoint.

The services furnished by the municipality must be investigated. Frequency and adequacy of garbage and trash collection may affect maintenance costs. Some cities do not make collections from apartment buildings at all, and the cost of disposal must be paid by the owner of the building.

Police and fire protection facilities are frequently important. Sites may be affected by requirements for entrance and exits and adequate turning space for fire fighting equipment or for police scout cars. Pumping capacity of fire fighting equipment may be inadequate for the height of building contemplated, which may require the installation of water tanks on the roofs, and provisions for standpipes inside the buildings.

Existing or proposed parks, playgrounds, public libraries, and similar civic features are desirable projects and should receive consideration in evaluating the site. A park directly adjoining a site gives pleasant views and a permanent protection against encroachment by neighboring buildings. Supervised playgrounds are of great value to families having small children, by providing safe places for recreation, keeping the children off the streets, and helping to keep them from annoying the neighbors (Fig. 11).

A good indication of the stability of a neighborhood may be found in the civic

Fig. 11. Supervised playgrounds are a better solution.

interests of the existing occupants as expressed by their interest and participation in neighborhood activities such as citizens associations and parent-teacher associations. The active participation on the part of the children in boy's clubs, neighborhood art centers, boy and girl scout troops, and similar organizations is also a good sign.

Due to the high percentage of car ownership, even in low income groups, the availability of parking space is of prime importance. Requirements for parking space may also form one of the requisites found in zoning laws or deed restrictions and may have a considerable influence on the layout of the proposed building and on its cost. On small lots in crowded urban locations the provision of the required amount of parking space may prove difficult and expensive. The possibilities of complying with the requirements and the probable cost of ramps, drives, and garages must be considered in relation to the cost of the ground. Public parking garages and public parking lots in the vicinity, if located within reasonable walking distance, may prove advantageous.

Walking time from parking space to building entrances should not be excessive, else the spaces contemplated will not be used. The possibilities for convenient locations should be explored.

FHA Classification

If Federal Housing Administration financing is contemplated for the proposed building, the local FHA field office should be consulted before making a definite commitment to purchase a site in order to ascertain whether the proposed site is in an approved neighborhood and what classification will be assigned to it. Permitted density and type of building on projects which have FHA insured mortgages vary with the classification assigned the location, hence the desirability and value of the site for the purpose depends on the assigned rating.

As an actual matter of practice, the architect usually has little opportunity to

select from among many sites and must perforce take what is available and do his best with it. Most locations suffer from one or more faults and it is generally possible only to chose the least undesirable. Most urban apartment sites suffer from being too small and the usual conditions of varied ownership, minor heirs, and other legal complications make it impossible at times to assemble adequately large pieces of property at a reasonable cost.

Zoning laws which are in some matters too lax in their requirements are in other respects unduly restrictive. A zoning boundary running through a portion of a lot may cause a part of the land to be unusable so that the building must be crowded onto the remainder, whereas a reasonable distribution of the building on the site might actually improve conditions for all concerned.

PHYSICAL CHARACTERISTICS

Topography

Topography is an important element in determining the value of a site, as it affects to a large degree the cost of foundations and the layout of the buildings that can be placed upon it. In order to judge correctly the effect of the topographical conditions it is necessary to have an accurate survey showing contours, boundary lines, encroachments, and locations of utilities. Important natural features and the location of large trees should be clearly indicated.

With this information at hand it is possible to approximate the probable costs of grading, retaining walls, and other site improvements. Consideration should be given to the opportunities offered for proper building arrangement. For a further discussion of topography see section on Landscaping.

However, a lot should not be rejected too hastily because of rugged contours, since they may sometimes by careful study be turned into an advantage, adding features that would not be available on a level site. On a large building, or group of buildings, variations in height gained by following the contours may add greatly to the appearance of the buildings and grounds.

Investigation of soil conditions is an obvious necessity and must not be neglected. For purposes of land valuation the cost of piles or other expensive foundation work, excessive grading or retaining walls, the elimination of springs or ground water by means of storm sewer installations, and the cost of extending necessary utility lines to the property should be added to the cost of the site in comparing the land costs of various sites which may be under consideration.

Planning Considerations

Relation of the site to neighboring buildings, either existing or potential, should be checked for their effect on the outlook and orientation of the proposed building. There seems to be a tendency to ignore this factor, great attention being paid to the street sides of the building and portions of the building adjacent to the interior lot lines being brought as close to them as possible, without considering what may be built next door. When laying out a sketch site plan, the adjoining existing or probable future buildings should be indicated in their relation to the proposed new buildings, as this procedure may have a definite bearing on the new building's layout.

Size and shape of the site should be carefully checked, because the shape of the lot has an important bearing on the efficiency of the plan of the building which can

be put on it. Comparatively narrow interior lots of considerable depth may be found to have as much as half of their area entirely unusable and lots of irregular outline may constrict the building shape into an uneconomical form. In any case it is always a good idea to make several rough studies of possible building shapes on any lot under consideration having due regard for zoning laws and deed restrictions, before making any decision as to purchase of the site.

Consideration should be given to the possibilities for good orientation with respect to direction of sunshine, prevailing winds, and views, if any. Hazards in the form of fog, dust, smoke, or noxious odors from nearby industrial plants or railway lines should be carefully considered.

In cities which have, or are preparing Master City Plans, the site should be considered in its conformity thereto, and in the light of possible future city plan developments. Future extensions or widening of streets, and the construction of new streets or highways may have a decided bearing on the future value of the site. Depending on the type of improvement contemplated and its relation to the site, its influence may be either good or bad. The value of a site may be lessened if heavy traffic is brought so close to it that noises and fumes are objectionable to tenants. On the other hand, the value may be increased by a new street greatly improving the accessibility of the project to other sections of the city.

The proposed creation of parks, playgrounds, and other civic improvements may also enhance the desirability of a site by the amenities offered or by the effect of such improvements on the general character of the neighborhood.

COSTS

The first question a prospective client is likely to ask of his architect when he brings him a site for consideration is, "How much can I afford to pay for this lot?" To answer this question accurately the architect must have a knowledge of realty values in the neighborhood in question, so that after checking all the factors involved (see check list, page 28) he can proceed to the next step, which is to make a rough preliminary sketch of a building which will fit the site, in a complete enough form to enable him to estimate the rental which the building can reasonably be expected to bring. Sketches of this type are illustrated in Chapter 4. The actual value of the site varies with locality and with local regulations, and the architect must have at hand the ratios between rental and site cost for the locality in which he practices. In the Washington, D.C., area this ratio generally varies between 60% and 100% of one year's gross income. The precise percentage varies with the desirability of the location, whether it is suitable for high or moderate rent projects, and with the current state of the real estate market. Another method of determining site value sometimes used is a price of so much per apartment unit, or per room, however the ratio of rent to land cost is more accurate, as there is so much variation in room and unit sizes, in relation to rentals that this method is difficult to apply. On this basis the average land cost per apartment in the Washington, D.C., area will average from $350 to $500 for buildings in the moderate rental range and up to $600 to $700 per unit for higher rent projects.

The physical characteristics of the lot must also be carefully considered in determin-

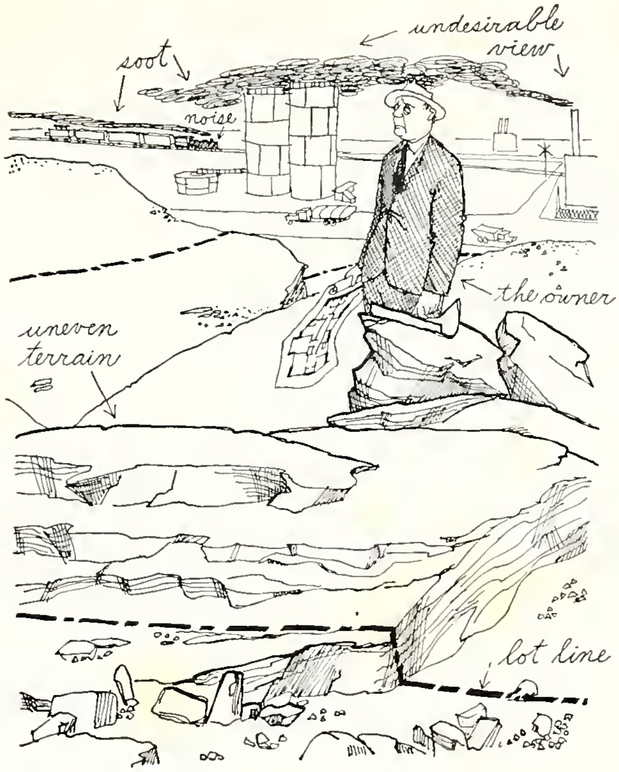


Fig. 12. The dubious bargain.

ing the value of a site. Uneven topography, poor soil conditions, lack of utilities, etc., can add greatly to the cost and it will frequently be found more advantageous to pay more for a really good site than to acquire a dubious bargain (Fig. 12). It must also be kept in mind that the cost of the site is generally a small item compared to the cost of the building which is to be erected upon it. The ratio of land cost to building cost usually ranges from about 10% to 15%.

A premium price paid for a really good site allowing for proper orientation, views, and freedom from hazards, well located in a good rental neighborhood, usually pays big dividends in the way of economy of construction, good rentals, and a minimum of vacancies. A cheap lot is usually no bargain. It should be borne in mind also that the value of the site depends on the number of really good rentable units which can be placed on it, and not on the greatest number of units which it is sometimes possible to cram in under existing zoning laws, which usually permit a density which is in excess of good planning standards. The practice of overcrowding lots always results in many undesirable units being incorporated in the building, as well as uneconomical building shapes and bulk, with dark interior spaces and narrow courts. This sort of planning results in higher building costs and apartment units which do not rent well or which have a high rate of vacancies. It should be obvious that the construction of a building of this type is uneconomical, but it is, as a matter of fact, very difficult at times to convince the builder that this is so.

The actual value of the site, therefore, is obtained by calculating the income to be expected from the building which can be placed upon it, multiplying this figure by the proper percentage, and subtracting the amount of any excessive or unusual costs which may be encountered by reason of its physical characteristics. Its location and other factors affecting its desirability should be accurately reflected in the assumed rentals, as an error in judgment as to the rents obtainable will make the

whole calculation invalid. It is a wise precaution at this point to consult an experienced real estate manager and obtain his opinion of the accuracy of the assumed rentals.

CHECK LIST OF ELEMENTS OF SITE SELECTION

A. Location

1. Neighborhood conditions
   a. type and use of existing buildings
   b. sizes of units in existing apartment buildings
   c. type of neighboring residents
      1. home owners or renters
      2. income groups
      3. social groups
      4. racial groups
   d. character of existing buildings
      1. maintenance standards
      2. general appearance
      3. predominantly old or new buildings
   e. rents in existing apartment buildings (see C-1)
   f. hazards (see B-7)
2. Zoning laws
   a. present requirements at site
   b. present requirements of adjoining neighborhoods
   c. possibilities of future changes
3. Stability of neighborhood
   a. possibilities of change to commercial or industrial uses
   b. number of mortgage foreclosures in existing buildings
   c. trends of variations in rentals in existing buildings
4. Deed restrictions
   a. set backs and/or lot occupancy requirements
   b. use restrictions
   c. uniformity of deed restrictions throughout adjoining neighborhood
   d. easements and rights of way (see B-1-f)
   e. approvals of plans required by former owners, trustees, etc.
5. Accessibility
   a. to public transportation lines
      1. walking time from site to stations or stops
      2. fares to various points
      3. frequency, speed, and adequacy of service
      4. traveling time to usual destinations
   b. taxi service
      1. availability
      2. fares to various points
   c. convenience for private cars
      1. capacity and type of public highways
      2. parking space (see A-7)
      3. driving time to various points
6. Neighborhood facilities
   a. commercial centers and shopping districts
      1. availability of employment
      2. adequacy of shopping facilities

3. walking time
4. access by public transportation lines
b. theaters (accessibility—see 6-a-3 and 4)
c. schools
1. type (public, parochial, nursery)
2. grades (grammar, junior high, high, colleges)
3. accessibility (walking time, access by public transportation lines)
d. churches
1. number, denominations, capacities
2. accessibility (walking time, access by public transportation lines)
e. hospitals and clinics
1. accessibility (by public transportation lines)
f. city services
1. garbage and trash collection
2. police and fire protection
3. adequacy of street cleaning and lighting
g. parks, playgrounds, public libraries, etc.
1. existing or proposed (see B-8-d)
2. accessibility (walking time, access by public transportation lines)
h. civic interests of existing occupants
1. citizens associations
2. parent-teachers associations
3. boy's clubs, scout troops, etc.
7. Availability of parking space
a. on site
b. off site
c. garages
d. walking time from main building entrances to probable locations of parking areas
8. FHA requirements and classification

B. Physical Characteristics

1. Topography (adequate topographical and boundary line surveys are required to determine the following elements)
a. amount of grading required
b. need for retaining walls
c. natural features (trees, streams, rock formations)
d. ground water
e. surface drainage conditions
f. encroachments (see B-4-c)
g. locations of utilities (see B-3)
2. Foundation conditions (test borings may be required to determine the following)
a. filled ground
b. bearing value of soil
c. requirements for piles, rock excavation, or other expensive foundation conditions
3. Utility lines
a. sanitary and storm sewers
1. combined or separate systems
2. depth of lines below grade
3. adequacy of existing sizes

        4. locations of manholes and invert elevations
        5. extensions required
    b. water supply
        1. location of lines
        2. adequacy of supply
        3. extensions required
        4. character of water (potability, hardness, etc.)
    c. gas
        1. type (natural or artificial)
        2. adequacy of supply
        3. cost
        4. extensions required
    d. electricity
        1. types of service (underground, overhead)
        2. points of entry to site
        3. extensions of lines required
        4. cost of current
        5. type of current (voltage, phase, cycles, alternating, direct, etc.)
    e. telephones
        1. type of service available (direct lines, PBX, secretarial service)
        2. extensions of lines required
        3. cost of service
    f. local utility company regulations for all the above services
4. Location of adjoining buildings
    a. existing
        1. size and heights as affecting proposed new building
        2. party walls
    b. future possibilities
        1. possible loss of desirable orientation
        2. possible future removal of undesirable neighboring buildings
    c. encroachments (adjoining buildings, fences, walks, etc. see A-4-c)
5. Size and shape of lot
    a. with respect to type of building desired (see C-2)
    b. possibilities for economical use of land
        1. zoning (see A-2)
        2. deed restrictions (see A-4)
        3. costs related to plan, etc. (see C-2, 3, and 5)
6. Orientation
    a. with respect to sunlight
    b. with respect to prevailing breezes
    c. with respect to views
    d. effect of existing buildings (see B-4)
7. Hazards
    a. noise and fumes from heavy traffic
    b. noise and fumes from industrial plants
    c. nearby railroad lines
    d. climatic conditions
        1. temperature range
        2. average number of degree days
        3. average wind velocity
        4. average snow and rainfall

8. Conformity to city plan
   a. planned changes in neighborhood patterns
   b. proposed changes in use of neighboring areas
   c. proposed changes in streets or highways
      1. elimination of streets
      2. planned new streets
      3. proposed extensions or widening of existing streets
      4. plans for other highway developments, such as cloverleafs, under or over passes, parkways, etc.
   d. relation of site to parks, playgrounds, or other civic developments, existing or proposed (see A-6-f)

C. Costs

1. Existing rents in neighborhood
   a. (see A-1 and 3)
   b. relation of rents in existing buildings to those proposed for new building
2. Shape, area, and heights of possible building (see A-2)
   a. in relation to shape of site as affecting building cost
   b. as related to orientation and views
   c. as related to existing buildings
3. Number of units to be obtained
   a. ratio of potential rental to site cost
   b. possibilities inherent in site for obtaining desired density of population
   c. number of potential units as related to probable costs of operation and maintenance
4. Probable costs of site work (see B-1, 2, and 3)
   a. grading
   b. retaining walls
   c. foundation conditions
   d. utility extensions
   e. landscaping
5. Value added for special features
   a. good orientation
   b. interesting views
   c. desirable natural features
   d. "swank" address
   e. good accessibility
   f. stable or improving neighborhood standards

CHAPTER 3: Building Types and Requirements

Rodney McCay Morgan

Fig. 13 (above). Lobby in an apartment building on Eye Street near 21st, Washington, D. C. Lester Rosenberg, owner and builder; Joseph H. Abel, architect. The glass front makes the small lobby appear larger than it really is.

Types of Building

The problems of apartment planning must be approached from several angles, as projects of different types vary considerably in their requirements.

As most major elements of design are determined by the nature of the site provided, the influence of this factor will be considered first. Buildings may be classified into two broad types according to the relative size of the site. The first type, which for purposes of discussion will hereinafter be referred to as the constricted type, is one on a comparatively small site in which the shape of the building must conform to and is determined by the shape of the lot. The second type, which will hereinafter be referred to as the free shape type, is a building or group of buildings on a large site in which the shape of the building or group of buildings is determined mainly by planning considerations and is to a large extent independent of and not confined by the shape of the site.

The planning processes employed on these two types differ radically. In the first, the shape of the building being to a large extent predetermined, the problem is to subdivide this shape properly into apartment units. In the second type, the problem is to combine selected units into a well shaped building or group of buildings.

Buildings may also be classified by their location as urban and suburban, and by the type of occupancy as low-rent, moderate rent, or luxury type.

City Apartment Buildings

Buildings of practically every kind from low rental to the luxury type will be found in downtown areas in large cities. Those on large sites permitting free shape buildings have planning characteristics similar to those involved in the design of suburban buildings and will be discussed under that heading.

The individual building on a constricted site is usually built as high as the zoning

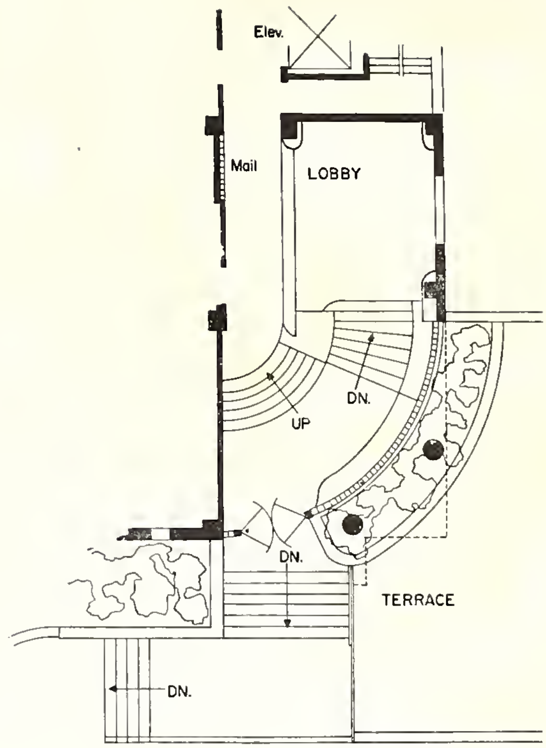


Fig. 14. Lobby in apartment building at 2720 Wisconsin Avenue, Washington, D. C. Henry K. Jawish, owner and builder; Joseph H. Abel, architect. Here the small size is relieved by the mirrored wall. This is a very small lobby, without office facilities, located in the corner of the building. The curved glass block wall is a practical and easily maintained wall finish and makes the lobby bright and cheerful by day and gives an interesting effect to the exterior at night. Shown, also, is the plan of this lobby.

laws permit, or where height is not limited by law, generally to a height of between thirteen to fifteen stories. Above this height unduly expensive mechanical installations are required for plumbing and heating services and the structural frame of the building increases in cost due to increased column sizes and wind bracing requirements. A few apartment buildings have been built to greater heights and may be economically justified under special conditions.

All buildings more than three stories in height should have elevators. Many buildings have been built above this height without elevators, especially in New York City, where there are numerous six-story walk-up buildings, but such buildings do not conform to modern housing standards. (For a further discussion see chapter on Elevators.)

Except in low rent projects, PBX or Secretarial switchboards are generally required, with an attendant in the lobby who also handles mail and package reception and distribution. Lobbies should be small in size, durably and attractively finished (Figs. 13 and 14), and should have space for reception and storage of packages for tenants, a manager's office, and office employees' dressing room and toilet room. Details of arrangements of these facilities are discussed in Chapter 7.

Due to the usual constricted size of the available sites and the generally built up character of the neighborhood it is seldom that anything can be done in regard to orientation. Careful attention to the shape of the building in relation to the site, and skillful location of window openings with an eye toward obtaining the maximum amount of privacy, are the most important considerations under the circumstances. For instance it is best to avoid, whenever possible, adjacent rooms of different apartments at right angles to each other, as shown in Figs. 15 and 16. A unit as shown in Fig. 17 will give greater privacy and also enable more use to be

Fig. 16.

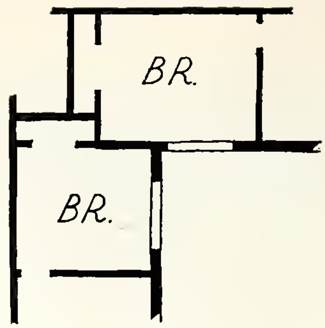


Fig. 15.

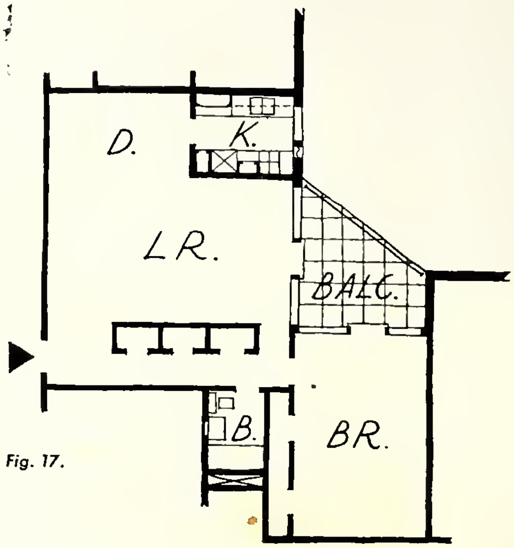


Fig. 17.

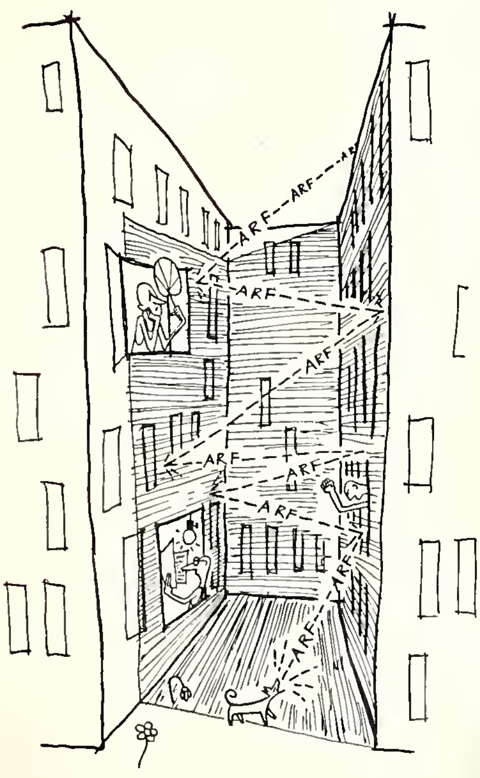


Fig. 19.

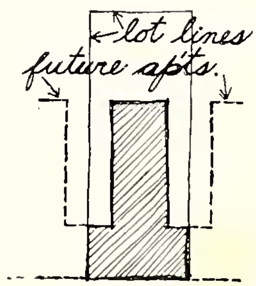


Fig. 18.

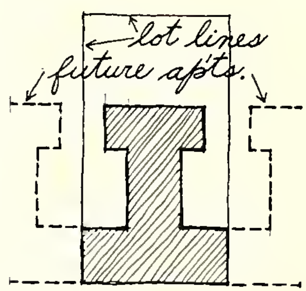
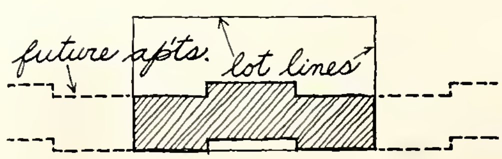


Fig. 20.

Fig. 21.



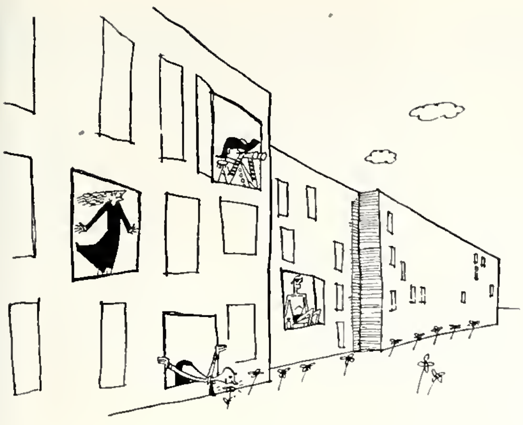


Fig. 22.

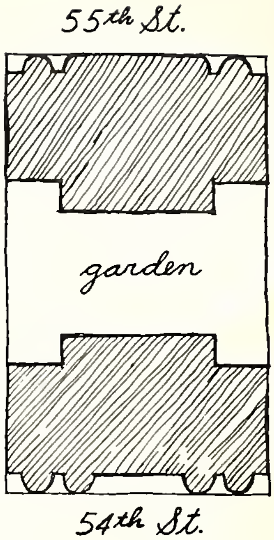


Fig. 23.

made of interior space which might otherwise be wasted. The usual narrow deep lot confines the shape of the building to a "T" as indicated in Fig. 18. The only building shape worse than this, on an interior lot, is the "H" which may be used on slightly wider sites (Fig. 20). These two plan types should be used only when their use cannot be avoided, because with adjacent buildings forming narrow courts, the apartment units receive a minimum amount of light, air, and view. A wider, shallower lot, as shown in Fig. 21, is capable of far better development (Fig. 22). A good example of this type is seen in the plot plan of the Rockefeller Apartment as indicated in Fig. 23, where advantage is taken of a through lot running from street to street. Placing two such buildings back to back and creating a pleasant garden court between them is the best possible solution for this type of lot.

Where the size and shape of the lot permit the placing of wings not parallel to each other, as indicated in Fig. 24, the amount of light, air, and privacy is greatly increased (Fig. 27).

It is generally felt that in order to justify prevailing high land prices in congested urban areas that it is necessary to crowd on to such sites all the units that the zoning laws permit. A careful analysis of the building plan in relation to estimated rentals, construction costs, and return on investment will, however, frequently show that in many cases this is not true. A smaller building, with a more efficient layout and an avoidance of deep narrow courts, will usually show a return as good or better than the overcrowded building, and will also create better living conditions for the building's occupants.

For example: An apartment building on a small lot as shown in Fig. 25 could have a wing added, as shown in Fig. 26, resulting in the gain of one more apartment per floor. However, the required building area is disproportionately increased by this

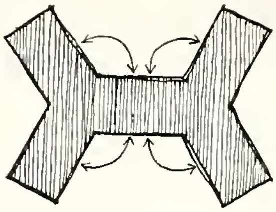
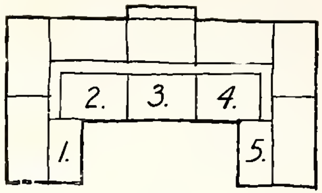


Fig. 24.



F'g. 25.

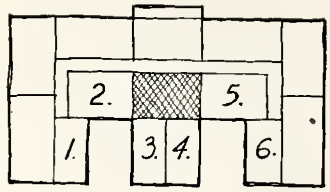


Fig. 26.

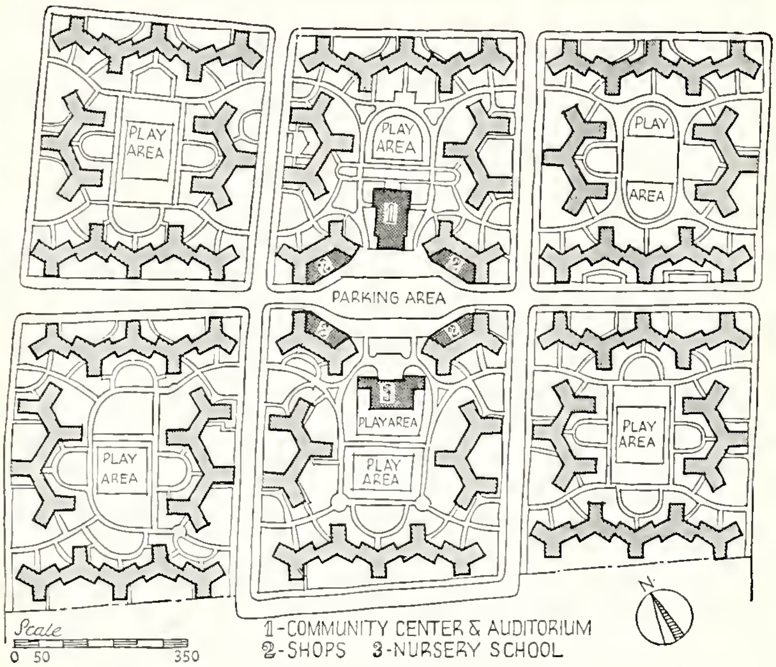
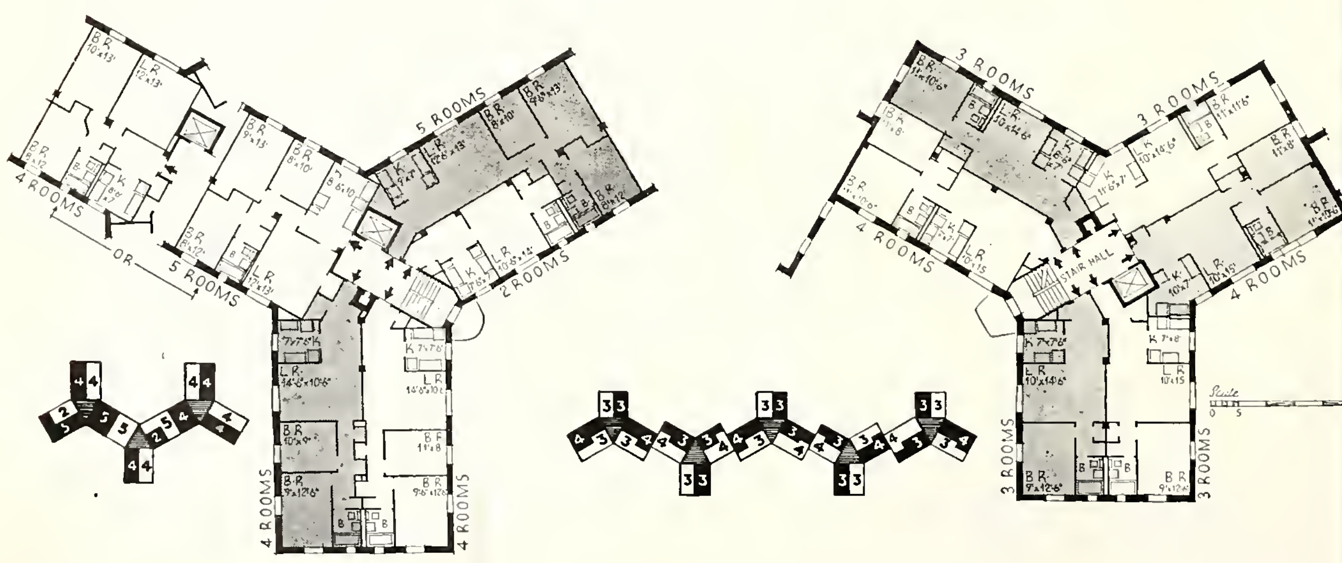
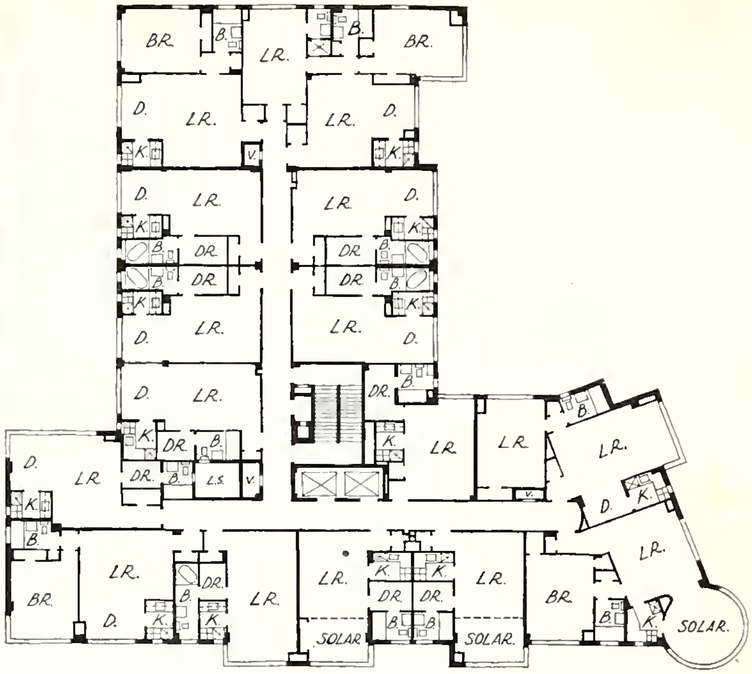


Fig. 27. Project at Queensbridge, New York, N. Y. William F. R. Ballard, architect; Henry S. Churchill, Frederick G. Frost, Burnett C. Turner, chief associates. This project shows the application of a slanted wing plan throughout a large development and gives an idea of the effect of openness that can be achieved through its use. Architectural Forum.



Rodney McCay Morgan

g. 28. The Washington House, Washington, D. C. Mark Winkler, owner; vin Aubinoe Construction Co., builder; Joseph H. Abel, architect. A mixture unit types having a large percentage of efficiency units combined with one d two bedroom units. Note that the room at the end of the corridor at the ar of the building is so arranged that it can be combined with the corner it to make a two bedroom apartment, or it can be cut off and rented by itself a single room and bath. The inside baths used here are lighted by a large aft as required by the building code at the time this building was erected.



The building is eight stories high and is completely air conditioned. The very small kitchens used are no longer legal, as the present code requires a minimum of 60 square feet. However, the kitchens have functioned well in practice. For small units of this type the requirement of 60 square feet is excessive.

addition, the portion shown hatched being almost all dark, lost space and the apartments on the resultant narrow courts being undesirable would have to be rented at a lower rate than the corresponding units in Fig. 25. Assuming for purposes of illustration an apartment rent of $80 per month for the units in Fig. 25 and a rental of $76 for the less desirable units shown in Fig. 26, then the respective incomes of the affected apartments are:

Fig. 25 . . . 5 apartments @ $80 per month = $400.
Fig. 26 . . . 6 apartments @ $76 per month = $456.

Assuming the capitalized worth of an apartment on today's market as being eight times the yearly rent, then the amount added to the value of the building by the extra wing is $56 \times 12 \times 8$ = $5,376 per floor. The total area added to the building in gaining the extra apartment is about 1600 square feet per floor, which at a cost of $5 per square foot will add $8000 per floor of building cost. The amount gained in ground cost by the extra units would be slight. Assuming a ground cost of $500 per unit for Fig. 25 with a building ten stories high, then the ground cost per unit for Fig. 26 is reduced by only about $90. Thus the added apartment costs about $7,910 and has a value of only $5,376. Clearly an unprofitable investment.

It will be noted in this example, which is admittedly a fairly extreme case, that even with no decrease in rent for the apartments affected by the addition of the extra wing, that the increased rent still would not pay for the increased size of the building. This method of analysis applied to buildings on constricted sites will often enable the better scheme to be chosen.

The usual range of apartment sizes in any one building is usually limited to two or three as follows:

Type 1. *Buildings containing mostly efficiency units with a few one bedroom apartments.*

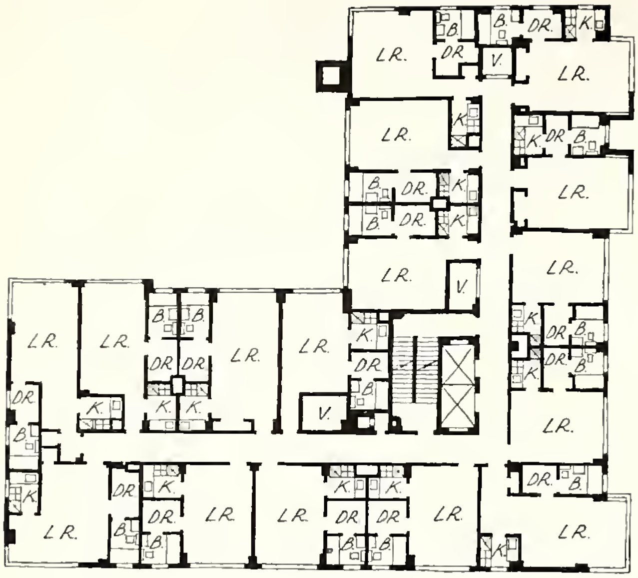


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Fig. 29. The Croydon Apartment, Washington, D. C. Joseph H. Abel, architect; John J. McInerney, owner and builder. An example of Type 1, this eight story building containing 126 efficiency units, is located in a downtown area. Note that the units used here have inside kitchens and outside baths. The building code in force at the time this building was erected permitted inside kitchens but did not permit inside baths. This law has since been changed and inside baths are permitted in Washington, D. C., but inside kitchens are not permitted.

Type 2. *Buildings containing one and two bedroom apartments with possibly one or two tiers of efficiency units.*

Type 3. *Buildings composed of luxury type units.*

In Type 1 buildings the matter of location is of prime importance. They should be within walking distance of working, shopping and amusement areas, and public transportation lines.

The great majority of the tenants of this type of building are unmarried working people or young married couples both of whom are employed. An intown location offers many conveniences to the tenants and is a big factor in the rental appeal of such buildings (Figs. 28, 29).

Roof decks for sun bathing and for lounging on hot summer evenings have considerable rental appeal and may be provided at little expense (Fig. 30).

Individual balconies, placed to take advantage of such views as may exist, are a highly desirable feature and where provided they are generally extensively used. Care must be taken to locate them with due regard for privacy. Where they are close together or in continuous rows they should be shielded from one another by screens or partitions (Figs. 31, 33).

Inclusion of commercial facilities such as eating places, beauty parlors, barber shops, branch laundry stations, drug stores, etc., will prove a great convenience to the tenants as well as a good source of income to the owner of the building. Where such facilities are included care must be exercised to restrict the placing and use of signs so as not to detract from the appearance of the building.

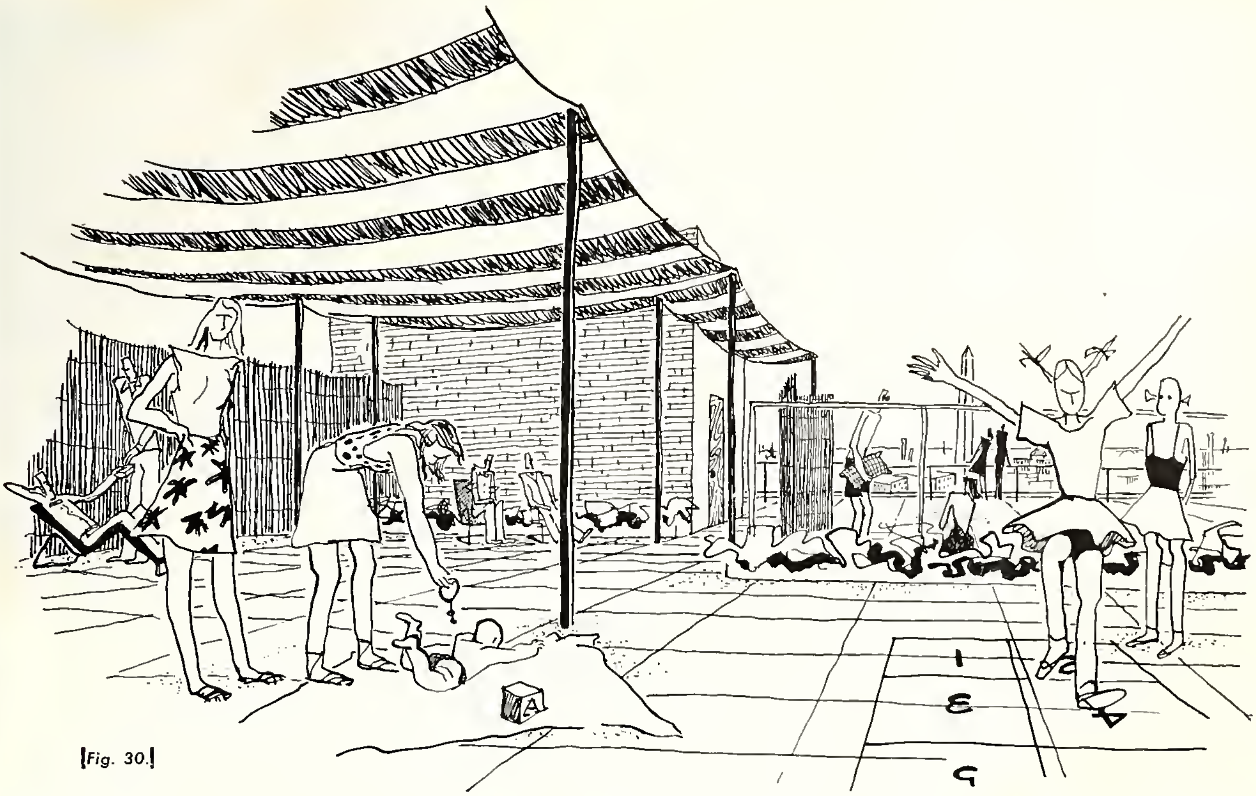

Fig. 30.

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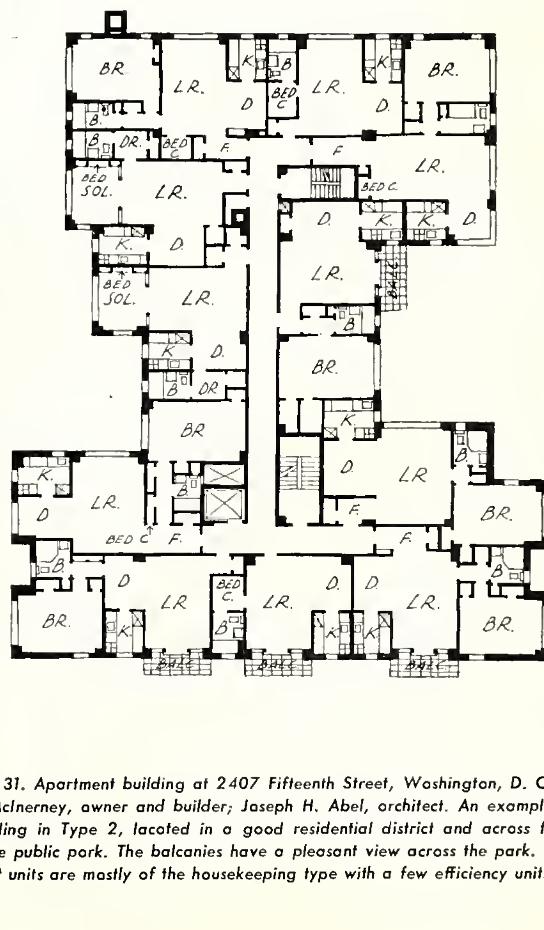

Fig. 31. Apartment building at 2407 Fifteenth Street, Washington, D. C. John J. McInerney, owner and builder; Joseph H. Abel, architect. An example of a building in Type 2, located in a good residential district and across from a large public park. The balconies have a pleasant view across the park. Apartment units are mostly of the housekeeping type with a few efficiency units.

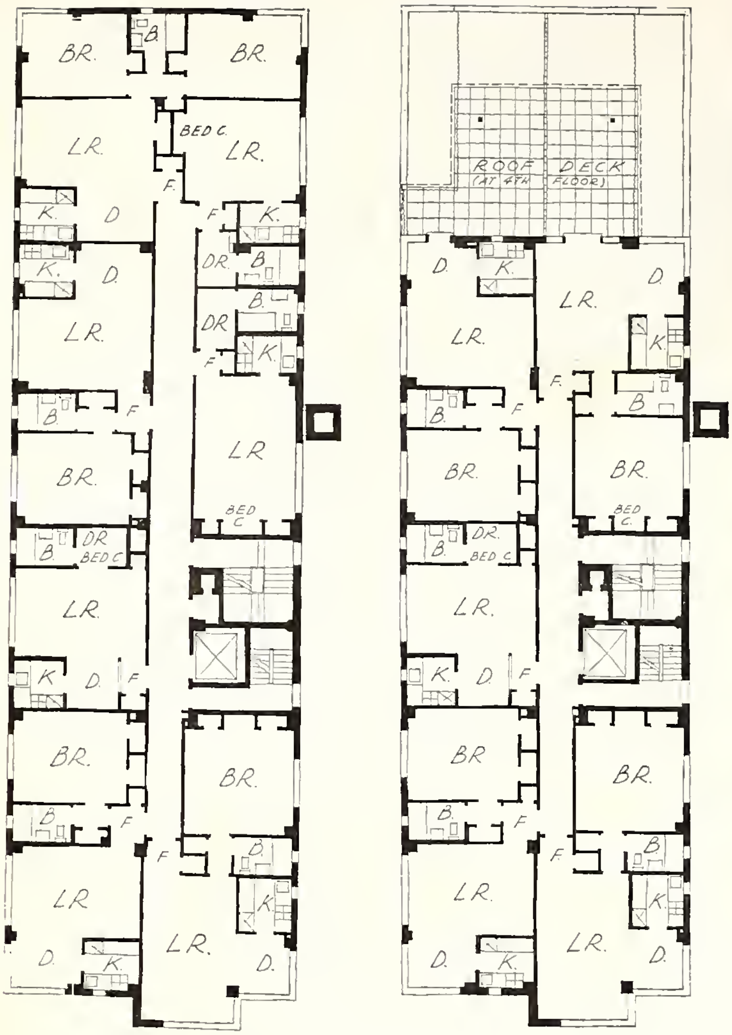

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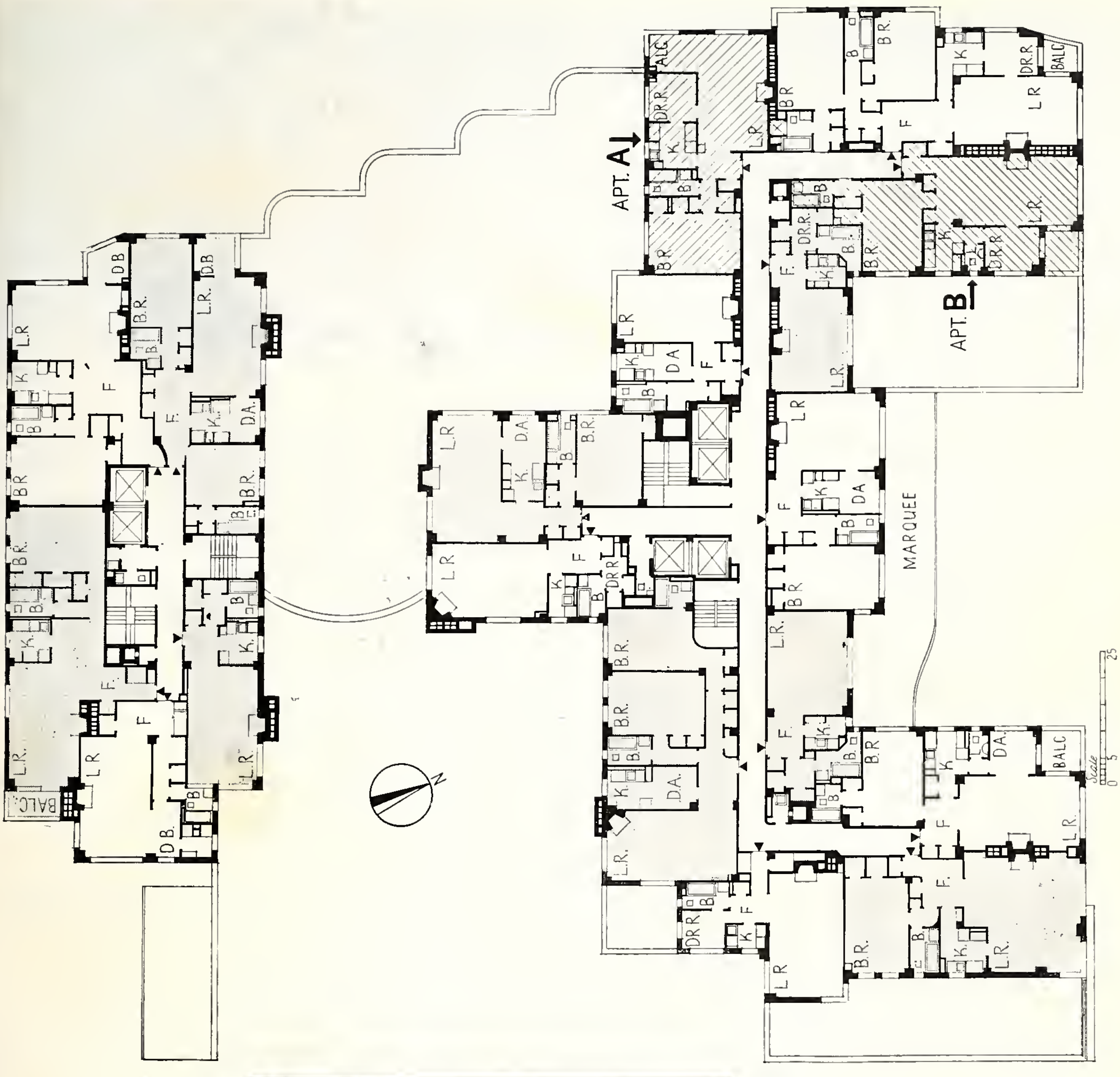
Fig. 32 (above). Apartment building at 2720 Wisconsin Avenue. Henry K. Jawish, owner and builder; Joseph H. Abel, architect. Another building in Type 2, located in an uptown location, with good transportation facilities near at hand. This location is one of the highest points in the District of Columbia and the roof garden gives a superb view over the city. The setback on the rear of the building at the third floor line is in conformity with a requirement of the District zoning law, and advantage was taken of this setback to provide roof terraces for the adjoining apartments.

Fig. 33. The balconies (at right, above) being close together are separated by screens of glass block to provide privacy. The front edge of the block is held in standard aluminum channels.



Richard Garrisan

Fig. 34. Apartment building at 240 Central Park South, New York City. Mayer and Whittlesey, architects. This building has a mixture of unit types and is a splendid example of the way in which many types of facilities may be integrated into the structure without harming the residential character of the building. This building contains practically every possible type of facility. The plan is a good example of sensible use of land. Considering the general density of the neighborhood in which it is built it preserves a remarkable amount of openness. The building covers about 48 per cent of the lot, which is a low amount for the district in which it is located. This low coverage has enabled the architects to produce good unit plans, having desirable amenities in the form of flexible arrangements, good views, and ample light and air.

Paal Peters

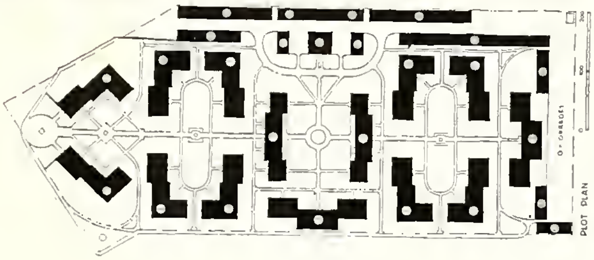


Fig. 35. Parklane Apartments in Houston, Texas. Talbott Wilson and Irwin Morris, architects; landscaping by Meyer and Johnson. Built on a 7½ acre site it contains 140 apartment units and 572 rooms in 14 two-story buildings. The loan is insured by the Federal Housing Administration. Each unit has either corner or through ventilation. Units in scheme, marked "G," are garages. The vista through the center building into the adjoining court helps to alleviate a shut-in feeling which might result from the narrow courts. The general architectural character is interesting and pleasant. The introduction of stuccoed surfaces prevents the monotony of uninterrupted surfaces of dark brick. The preservation of the existing trees and the general landscaping scheme contribute a great deal to the domestic atmosphere achieved. The pseudo-colonial entrances do not fit well into the picture, a simple projecting hood or canopy would probably have looked better.

Type 2 buildings are generally located somewhat farther from the heart of the city, and buildings of this type will be found at varying distances out to the suburbs. The general facilities discussed under Type 1 are also applicable here with the addition, where possible, of party rooms, hobby rooms, and play rooms. Where space is available provision should be made for garden space and outdoor play facilities for children (Figs. 31, 32).

Type 3 buildings are generally built only in premium locations, such as those commanding desirable river, lake, or park views or on streets which have "swank" address value. Such buildings, commanding very high rents, must offer every possible service and facility. Servants' quarters are a necessity. Inclusion of restaurants and shops depends on the atmosphere sought. Some buildings desire the character of a high class hotel and some buildings depend on an atmosphere of quiet and exclusiveness.

It should be noted that an extremely careful analysis of the market for this type of building is required before embarking on a luxury type project, as experience has shown that even with very high rentals this type of building is generally a much less profitable investment over a long period of years than a moderate or low rental building.

It will frequently be found profitable, however, to include a few luxury type units in buildings which contain mostly moderate rental apartments. Where such units are included they should be given the best possible location, usually on the top story or as penthouses.

Space should be allocated for parking of tenants' cars, and is required under many zoning regulations. Parking requirements vary from one car per unit to one car for

Rodney McCay Morgan

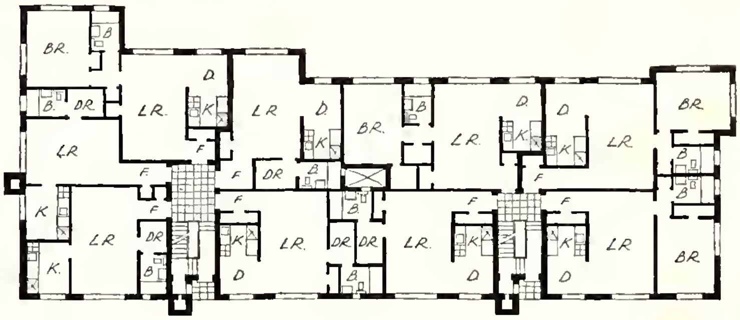


Fig. 36. Apartment building on Tunlaw Road, Washington, D. C. Frank S. Phillips, owner and builder; Joseph H. Abel, architect. A typical group plan building for a small lot. Note the locations of the incinerators in the stair halls and their treatment in elevation. The large living room windows give a feeling of spaciousness on the interior and add interest to the exterior treatment. The elevated planting at the base of the building helps to keep pedestrians away from the lower windows.

each five units depending on local regulation, or in the absence of such regulation, on the type and location of the building. In Type 1 buildings the percentage of car owners will be least and one parking space for each four units will generally be adequate. For Type 2 and 3 buildings parking space for one car for each two units is about a minimum requirement, and some regulations require a parking space for each unit.

Suburban Apartment Buildings

The Garden Apartment, so called presumably because of a garden atmosphere developed by the landscaping of the surrounding courts and yards and built in outlying areas on relatively inexpensive ground, has for some time been in vogue as an ideal solution to the problem of moderate priced apartments. As usually built, they consist of two and three story buildings with units grouped around stairways (hereinafter referred to as the "group plan"), the usual plan having two or three units per floor opening onto the stairway, although some plans have four and even five units per stair. Corridors are thus not necessary and in the type having only two to three units per stair either through or cross ventilation is possible for all apartments (Figs. 35, 36, 37, 43).

Permissible density is generally set at 25 to 30 units per acre, with a lot coverage of not over 30%. The advantages claimed for this type of construction are:

1. Economy of construction due to elimination of corridors and elevators. (Three stories is the maximum height considered good practice for walk up buildings.)

2. Economy due to permitted use of wood floor joists instead of fire-resistive construction as required for higher buildings.

3. Through ventilation or cross ventilation for all units.

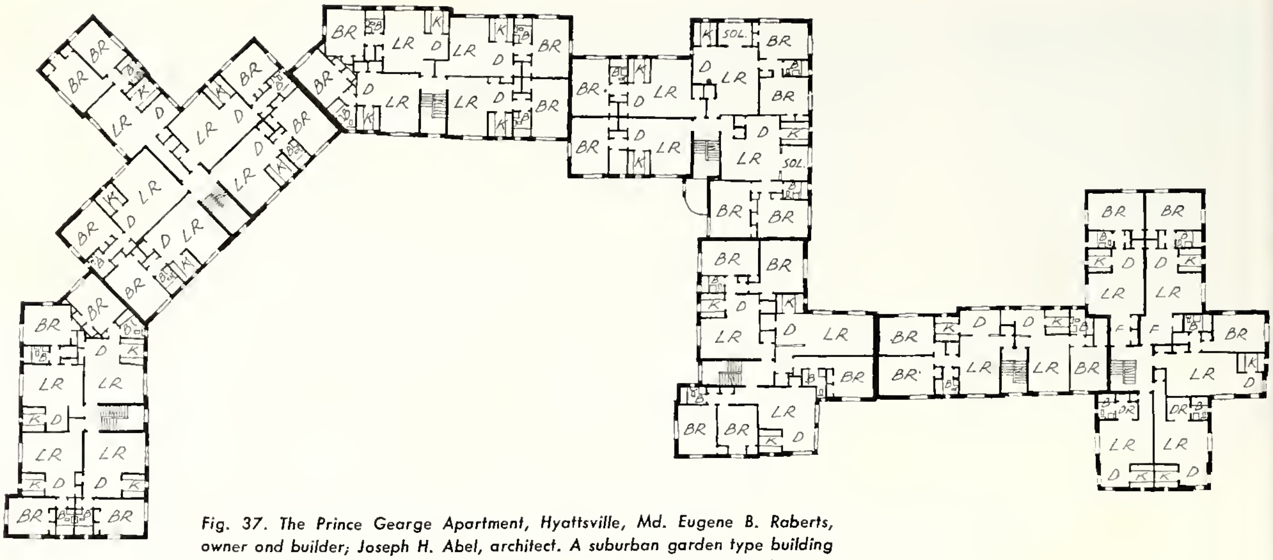
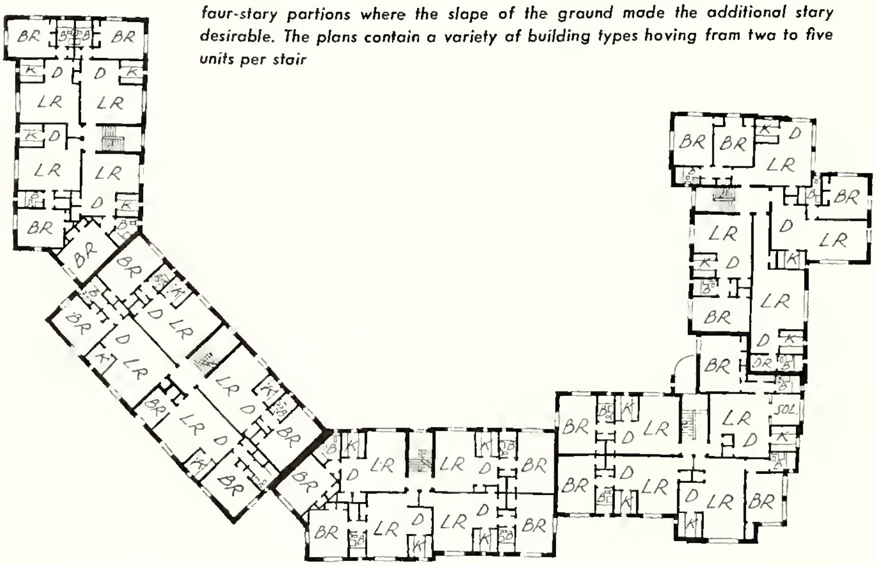


Fig. 37. The Prince George Apartment, Hyattsville, Md. Eugene B. Roberts, owner and builder; Joseph H. Abel, architect. A suburban garden type building on a site of about 4 acres, traveling time by auto to the center of Washington, D. C., is about 20 minutes. Consists mostly of three-story buildings, with a few four-story portions where the slope of the ground made the additional story desirable. The plans contain a variety of building types having from two to five units per stair



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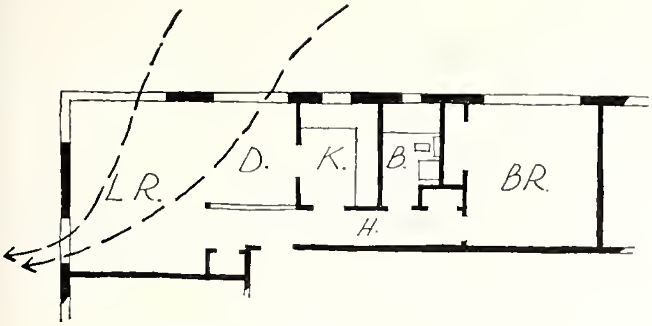


Fig. 38.

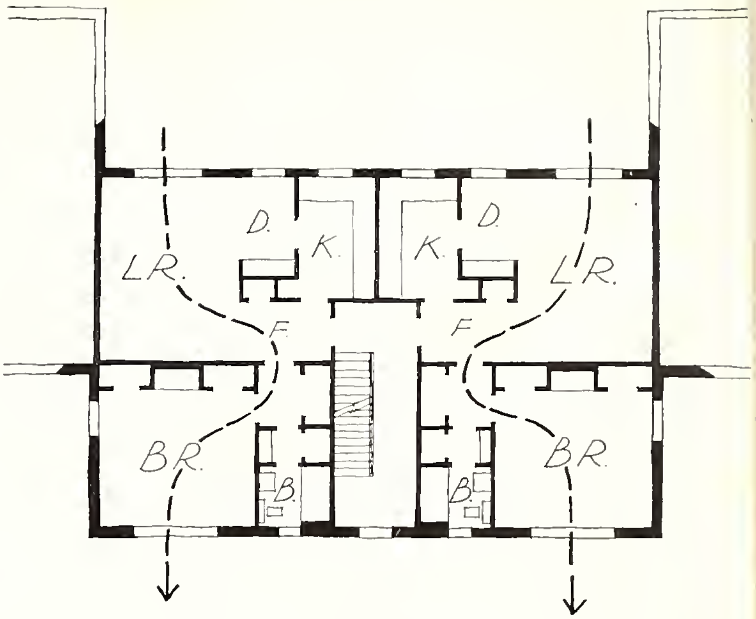


Fig. 39.

4. Economy of maintenance due to elimination of lobbies, corridors, and elevators.

5. A desirable type of living through closeness to the ground.

It is however, somewhat questionable whether all these advantages are actually realized in practice. The economy of construction claimed due to elimination of corridors and elevators is offset by the added perimeter of costly outside wall space and the increased number of stairs required. Many more utility stacks are necessary than in the multi-story building and outside utility lines have longer runs. The possible saving due to use of wood floor framing was not very great even before the war, the cost differential at that time between concrete and wooden floor framing being about $100 per unit. With the high cost of lumber prevailing at the present time, the cost of fire resistive construction is never more and in some cases is less than that of wood framing.

It should also be noted that the cost of maintenance in wood framed buildings is higher than that of concrete buildings due to shrinkage cracks which require much pointing up of plaster and repainting of rooms. Even if great care is taken in the framing these shrinkage cracks can hardly be avoided, unless steel framing is used to permit the elimination of wood bearing partitions. It will be found that the use of steel framing will increase the cost to that of an entirely fire resistive building without the other advantages inherent in fire resistive construction.

A comparison of two projects built in 1941 is a good example: The first, a group of three story buildings, containing 152 apartments, grouped around stairs, and having wood floor joists, carried on steel beams and columns, cost $550,000 or $3,618 per unit. The other, an eight story reinforced concrete building, with two elevators, contained 98 apartments and cost $354,000, or $3,615 per unit.

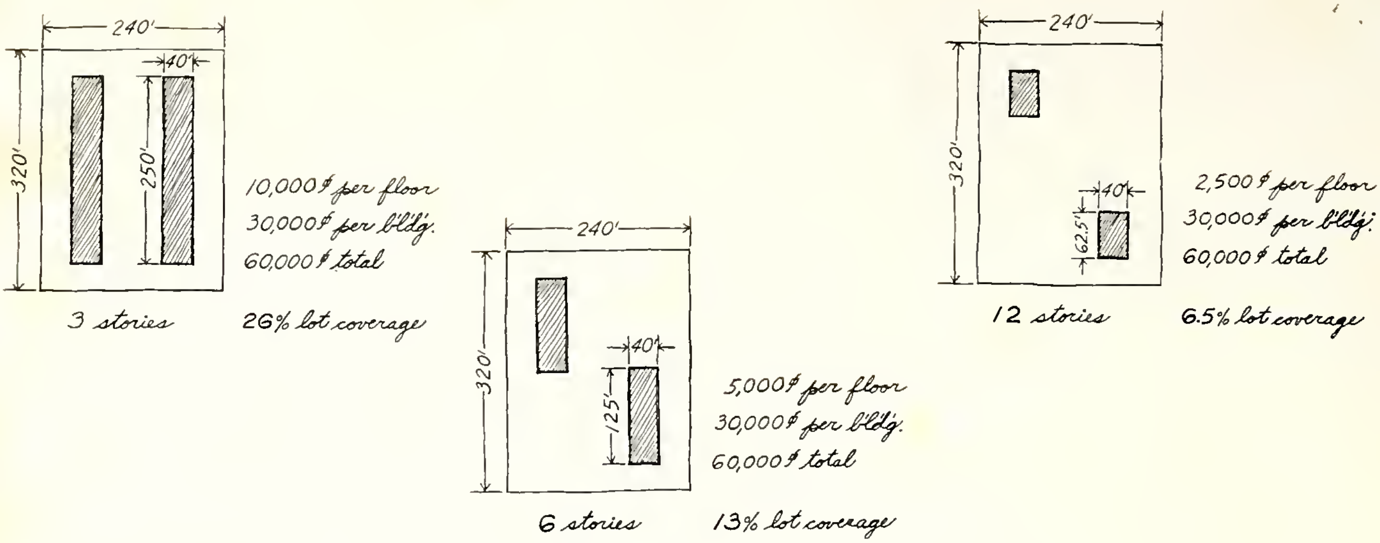


Fig. 40. Graphically illustrates the difference in land coverage required for buildings containing the same total number of square feet of floor area of varying heights.

Through ventilation or corner ventilation has been set up in many housing standards as a very desirable or essential requirement. Through ventilation is considered provided when windows are placed in opposite parallel walls of the unit, and corner ventilation when only one room of the unit has windows in walls at right angles (see Figs. 38, 39). Even in detached houses, which have a maximum of exposure, on hot breezeless nights, the interiors are stifling and uncomfortable and many occupants of such houses install attic fans or air conditioning units. In apartments, where at best the availability of natural ventilation cannot possibly be as good as in the detached house, natural ventilation is highly inadequate to produce comfortable conditions in hot weather. The only really adequate solution is a system of mechanical ventilation which will insure a positive air circulation whenever required. Further details of such systems are discussed in a later portion of this book.

Another planning economy possible in multi-story buildings is the use of interior, mechanically ventilated bathrooms, which are not feasible in two and three story buildings, and in many states are prohibited by law in buildings under five stories in height.

In a comparison of 19 different three story buildings planned by our office, consisting of 12 projects of group type buildings and 7 corridor type buildings, all having approximately the same room sizes, in the group type buildings the gross area divided by the number of rooms equals 255 square feet; in the corridor type buildings the gross area divided by the number of rooms equals 261 square feet, a difference of only 6 square feet in favor of the grouped plan and an amount too small to have any significant effect on the cost of the buildings.

In our own practice we have generally used group plans on 3 story buildings on very small lots where 4 or 5 units per floor was the greatest number obtainable,

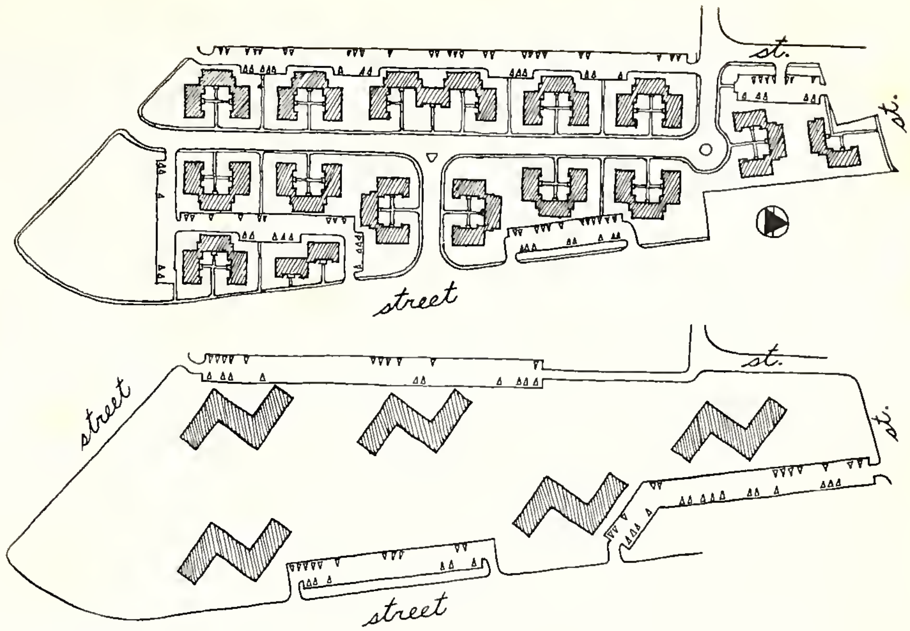


Fig. 41. At the top is a layout of 3 story buildings containing 540 apartments. Below, layout of the same lot using 6 story buildings containing the same number of units. Six story buildings were used because that was the maximum height permitted by the local zoning law on this particular site. The number of project roads required is greatly reduced and the outlook of all units and their orientation is greatly improved. The amount of open space remaining is concentrated into large areas, capable of being beautifully landscaped and developed into useful recreation areas and gardens.

and on groups of 3 story buildings on very large tracts of ground with a comparatively low permitted coverage. In the second case, although we favor the development of such tracts with taller buildings, as is discussed later in this chapter, if the client for some reason wishes to confine the operation to 3 story buildings, the group plan is usually advantageous:

1. It is the only type on which the FHA will insure loans, as their regulations require all units to have either cross or through ventilation.

2. The corridor in a corridor type building would not be used to its full advantage, due to the low lot coverage and limited building height.

On lots of moderate size suitable for buildings of say 12 to 20 units per floor, the corridor type building will generally permit more units per floor than the group type, particularly if the lot is comparatively narrow and deep.

As to the desirability of living close to the ground, first floor units in any building will give the same proximity regardless of the number of stories above, and it will be found that many people do not want to live too near the ground for several reasons, chief among them being a lack of privacy caused by first floor windows being exposed to the view of passers-by and giving easy access to prowlers. In many buildings the upper floors are desirable because they give unobstructed views over long distances and many tenants appreciate these views, as is shown by their willingness to pay a premium to obtain them. An examination of the rental schedules of multi-story buildings will generally show that rents are graded from the upper stories down.

The site plans, particularly of very large projects of 2 and 3 story buildings, while generally presenting a pleasant and orderly appearance on paper, usually produce a

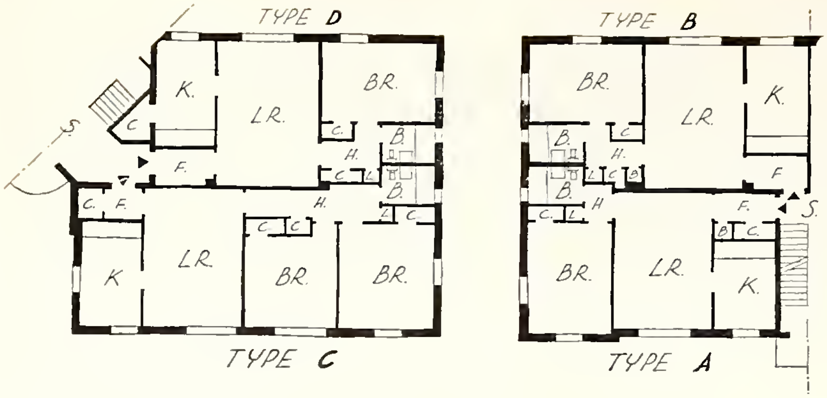


Fig. 42.

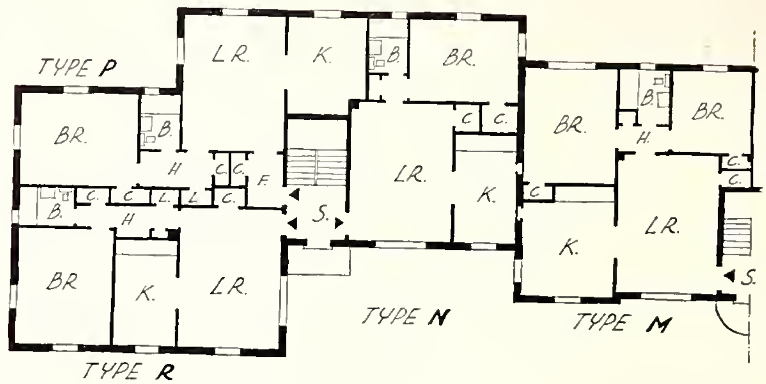


Fig. 43.

Fig. 44.

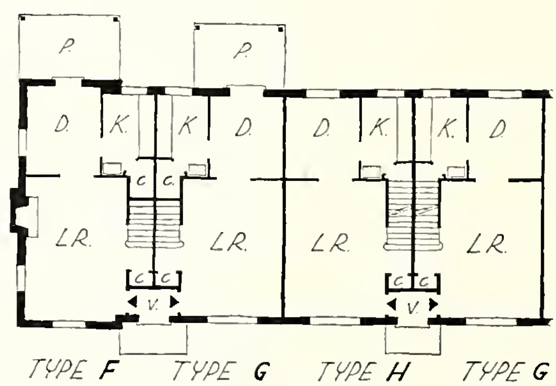


Fig. 45.

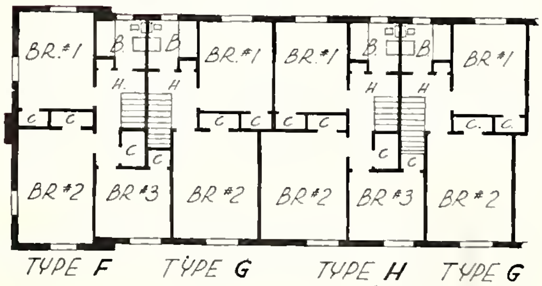


Fig. 46.

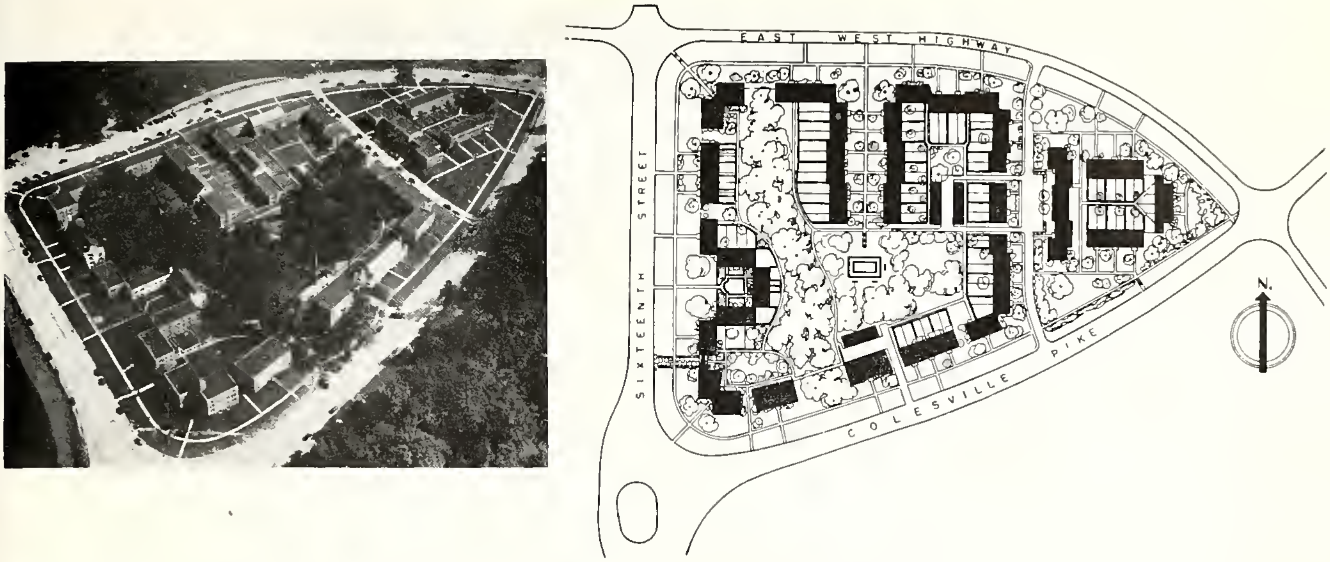


Fig. 47. Views of Falkland Apartment project, Louis Justement, architect. Duplex units are used here in combination with other apartment types, varying in height from 2 to 3 stories.

sense of confusion when viewed on the site, due to the fact that the geometric forms and curves which fall into nicely balanced groups on paper are not visible from a normal viewpoint on the site, and the seemingly endless repetitions of small buildings which vary usually only in minor details, produce a sense of dreary monotony and confusion. The same effect greatly accentuated is, of course, produced by large groups of multi-story buildings, provided they are built relatively close together. However, if on comparable sites to those used for 2 and 3 story buildings, we build multi-story buildings limited to the same population density as used for the low buildings, an opportunity for planning of an entirely different order is opened up.

Assuming, for instance, that 8 story buildings are to be used, apartment units giving the same population density will cover only three-eights as much ground, leaving free for garden, planting, and parking space a much larger area than would be available if 3 story buildings were used. Space between buildings is greatly increased giving an effect of openness and avoiding the cluttered effect of 3 story buildings. Much greater freedom is possible in determining the most desirable shape and size of building to be used because of the greater ground area available. It is also possible to orient the buildings and place them so as to take advantage of sunlight, prevailing winds, views, and to avoid direct views into adjoining buildings (Figs. 40, 41).

Building cost, as already discussed, is no greater for the multi-story building and land cost per apartment unit is the same. Due to the greatly reduced number of entrances required, control is greatly simplified and the layout of walks and drives is much more economical, because of the reduced number and length required to service the buildings. In multi-story buildings it is possible to place a laundry unit in the basement of each building, thus giving direct vertical circulation from each

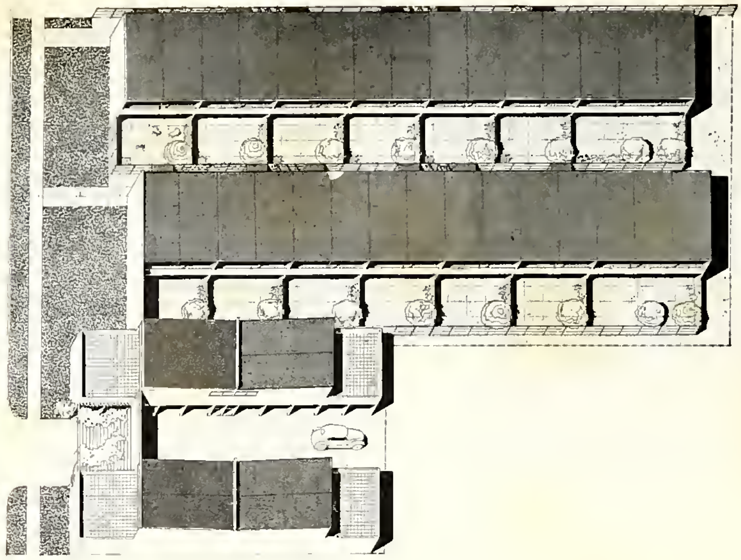
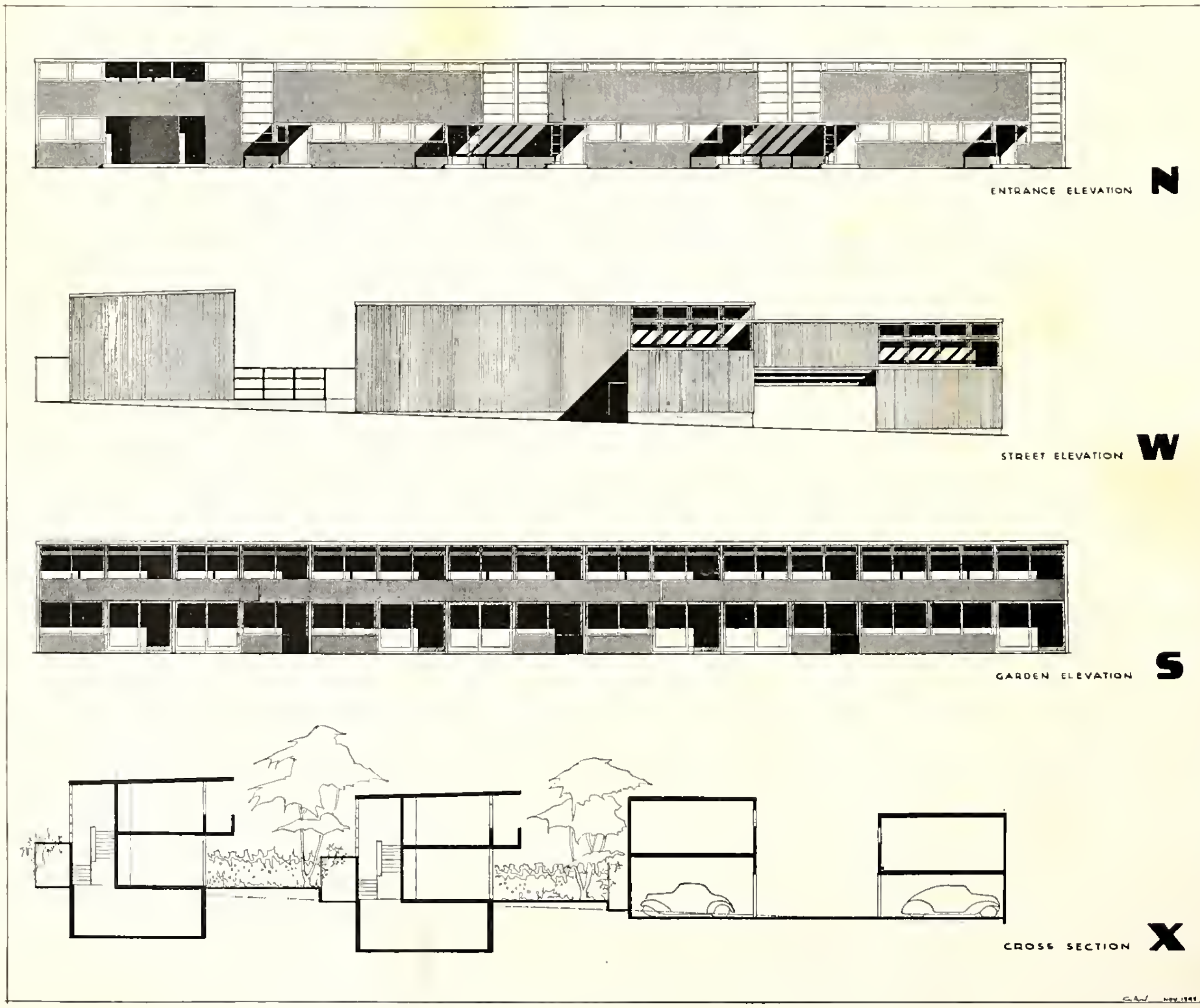
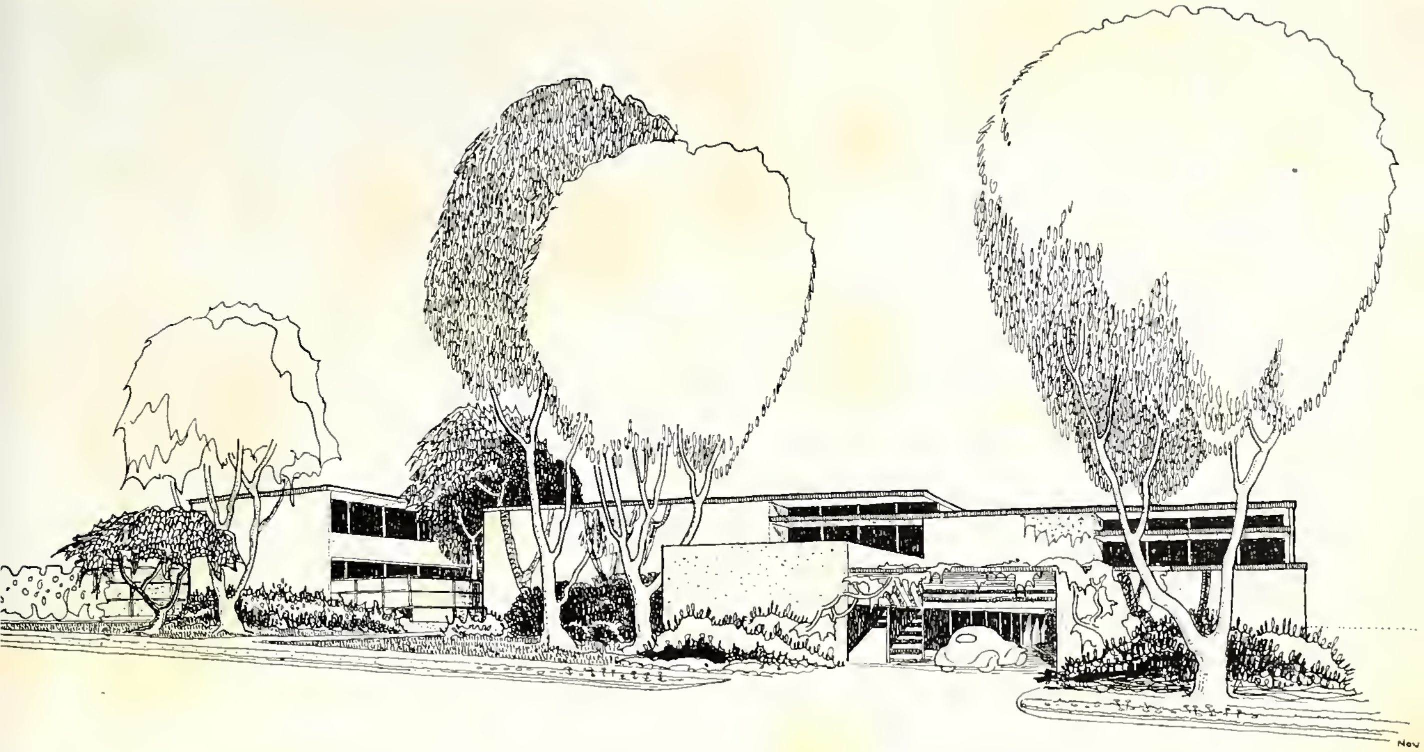
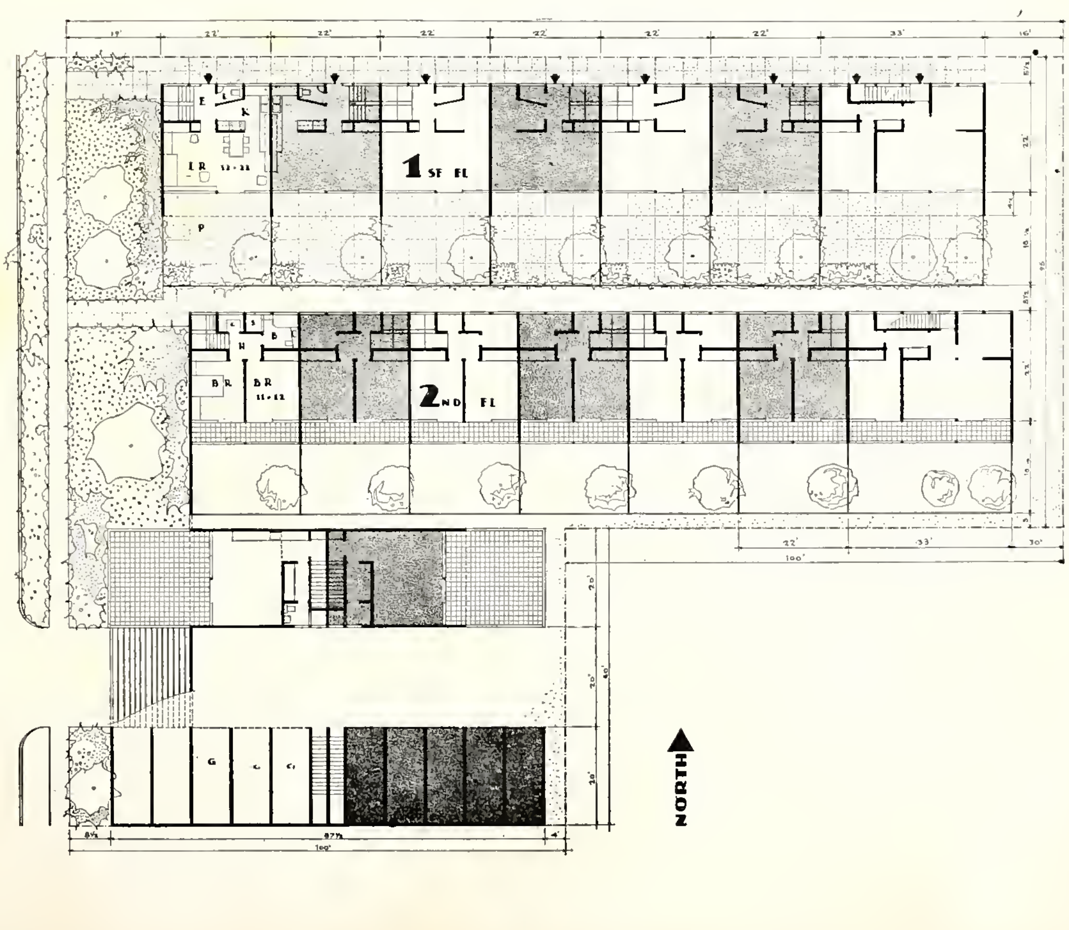


Fig. 48. A scheme for a group of duplex apartments by Gregory Ain, architect. These units are designed to provide family accommodations similar to those found in small houses, combined with many of the advantages of apartment living. Note the privacy obtained by concentrating stairs, kitchens, and baths on the entrance sides with living and bed rooms opening onto enclosed patios. All units have balconies opening from the bedrooms. There are small bachelor apartments above the garages.







19'
22'
33'
16'
1ST FL
2ND FL
LR
K
BR
22'
33'
30'
100'
G
87½
100'
NORTH

Julius Shulman

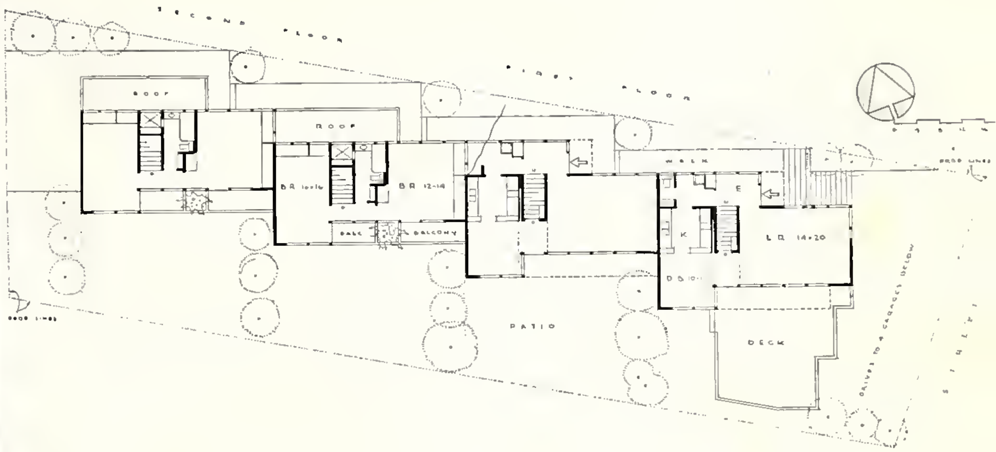
Fig. 49. The Dunsmuir Flat Building, Los Angeles, Calif. Gregory Ain, architect. An arrangement of duplexes, staggered for privacy. Each unit is a complete home with access to its own patio. All rooms have good ventilation and sunlight.

apartment to a laundry, whereas in the 2 or 3 story project it is usually necessary to walk through the yard to another building to reach a laundry.

The over-all maintenance costs of multi-story buildings, including care of corridors, lobbies, and elevators will be found in practice to be as low or lower than in the 3 story buildings. In addition, in the multi-story building it is feasible to supply a sufficient amount of facilities, such as laundries, drying rooms, storage space, indoor play space, etc. Most 2 and 3 story projects built heretofore have been seriously deficient in facilities of this type.

Another type of garden project which has some very real advantages in respect to amenities offered is the type known as duplex apartments. This is not the type usually called by this name which are 2 story units incorporated into a larger building, but are more nearly like row houses. They are built in rows, 2 stories high, and contain on the first floor a living room, eating space, and kitchen, with bedrooms and bath on the second floor. In some projects of this type (Figs. 48, 49) second floors have an interlocking arrangement, giving one unit three bedrooms and the next unit one bedroom.

Such units are sometimes combined in groups with other more conventional apartment units as shown in the group at Falkland designed by Louis Justement (Figs. 42, 43, 44, 45, 46, 47). Individual entrances and garden space can be assigned to each dwelling unit or pair of units giving privacy and access to the ground similar to that enjoyed by individual row houses, combined with the advantages of central heating and other apartment services such as building, lawn and garden maintenance, snow removal, centralized laundry facilities, storage space, etc. (Figs. 48, 49, 50, 51, 52, 53).



Low Rental Projects

Low rental projects as usually built attempt to lower rents by:

1. Shifting as much as possible of the cost of maintenance and utilities on to the tenant. As for instance, the installation of separate heating units in each apartment and the shifting of the maintenance of lawns and walks to the tenant whose apartment they adjoin.

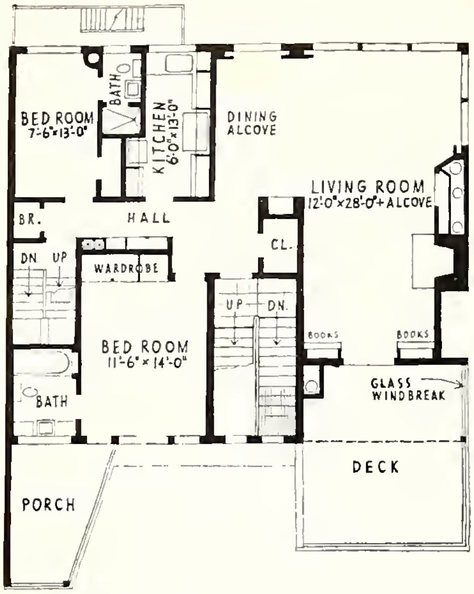
2. Reducing the number and size of rooms per person.

3. Increasing density to reduce land cost per dwelling unit.

4. Reducing building costs by eliminating or cheapening of various items as, for instance, elimination of closet doors, substitution of open shelving for kitchen cabinets, reduction of number of electric outlets, etc.

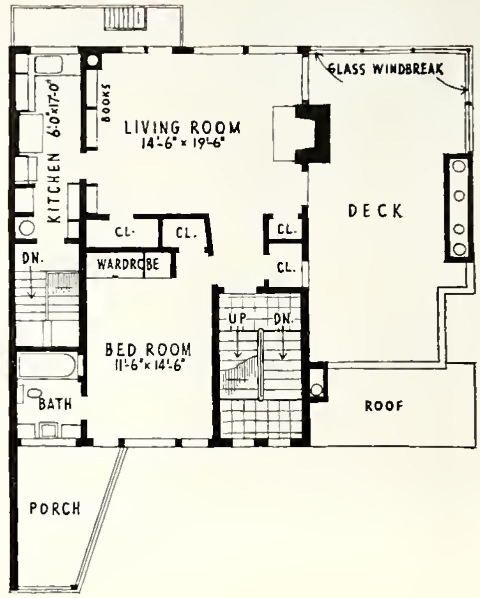
It is fairly obvious, that most of these dodges are futile. The amount of saving in building cost is too small to make any real difference, and except in cases of extremely high cost land, whose use for low cost projects is at least questionable, the difference in land cost gained at the expense of very high population density is not sufficient to make rents appreciably lower. The reduction of room sizes below generally acceptable standards does not decrease the cost proportionately to the amount of reduction of space, because the expensive components of utilities and circulation are not affected. Furthermore, the building of projects of excessive density and the crowding of more people into fewer rooms is exactly opposite to the intent for which such projects are built, which is the elimination of slums and the provision of good living quarters for people in the low income brackets.

The shifting of costs to the tenant, while it is indeed a saving to the building oper-



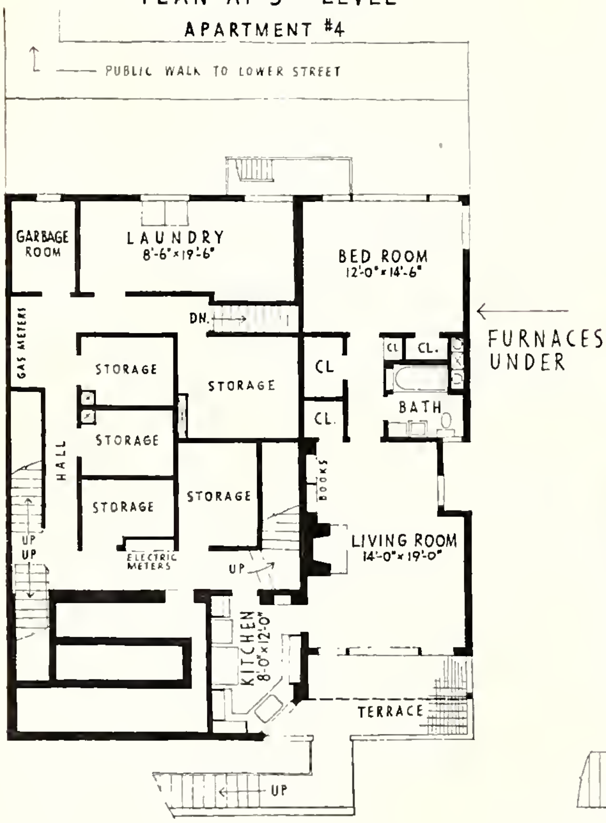
PLAN AT 3RD LEVEL

APARTMENT #4



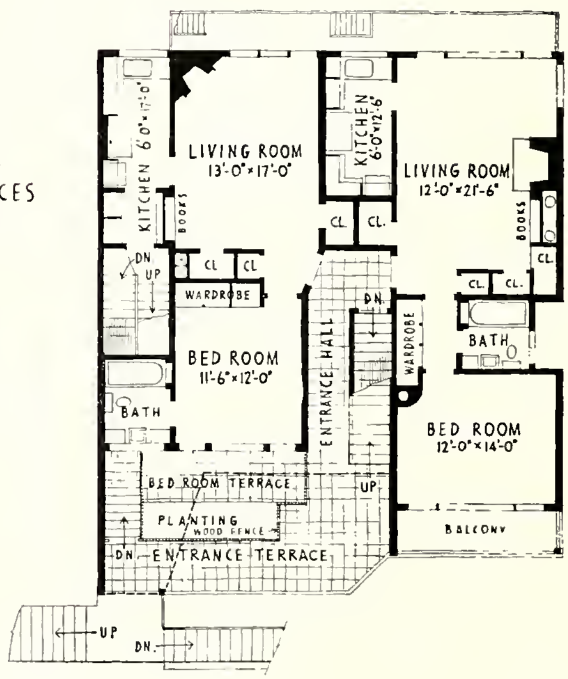
PLAN AT 4TH LEVEL

APARTMENT #5



PLAN AT 1ST LEVEL

APARTMENT #1 – LAUNDRY – STORAGE

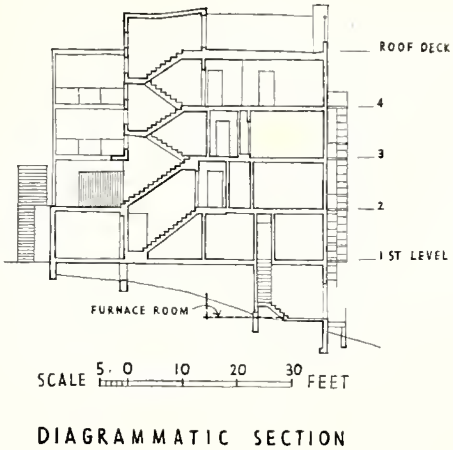


PLAN AT 2ND LEVEL

APARTMENT #2

Fig. 50.

Fig. 51.



Figs. 50–52. Sibbett Apartments, San Francisco, Calif. William Wilson Wurster, architect; Helen Van Pelt, landscaping. The stepped back plan is caused by the steeply sloping site and relationship to adjacent streets. Main objectives of the design were attainment of privacy, garden space, and good views for each unit. The resulting apartment units offer an unusually good living quality.

ator, results in higher costs to the tenant and so is not really a reduction in living cost. It seems to me that there are only a few directions in which we can look for any real reduction in costs. For example an average breakdown of the rental dollar of a unit renting for $15 per room would look somewhat as follows:

Profit and Federal taxes	18%	2.70
Vacancies	10%	1.50
Operating costs	26%	3.90
Local taxes	9%	1.35
Amortization and interest	37%	5.55
	100%	$15.00

If we allow 7% for interest and amortization this amount will support a per room cost of $951, the amount spent for interest and amortization being $66.60. Assume that we wish to reduce the rent per room by 10% to a rental of $13.50. Our table would then look something like this:

Profit and Federal taxes	2.43
Vacancies	1.35
Operating costs	3.90
Local taxes	1.35
Amortization and interest	4.47
Total	$13.50

This allows an amount per year for interest and amortization of $53.64 which at the same rate of interest and amortization will support a per room cost of only $766. This is a reduction in building cost of almost 20% in order to gain a rent reduction of 10%. Such a reduction in cost is not possible by small economies such as those mentioned above, nor indeed in any other known way under present building conditions and methods. It will be noted in the above table that on the lower rent unit no deduction has been made in the items of operating costs or local taxes as it is unlikely that a reduction in building cost would have any effect on them.

Julius Shulman

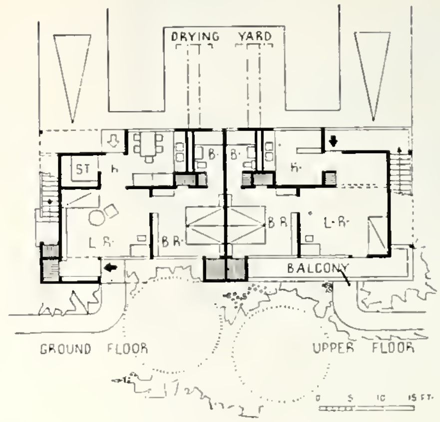
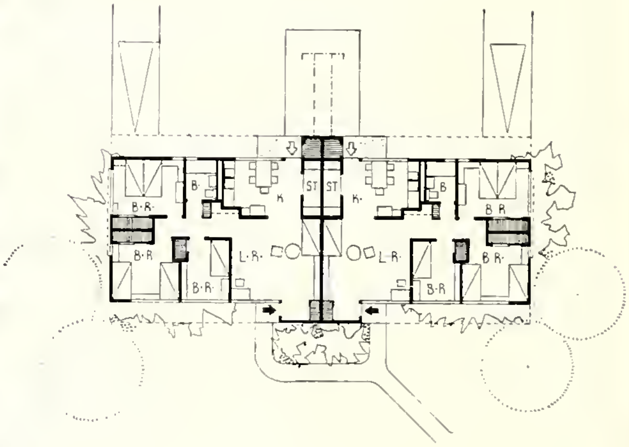
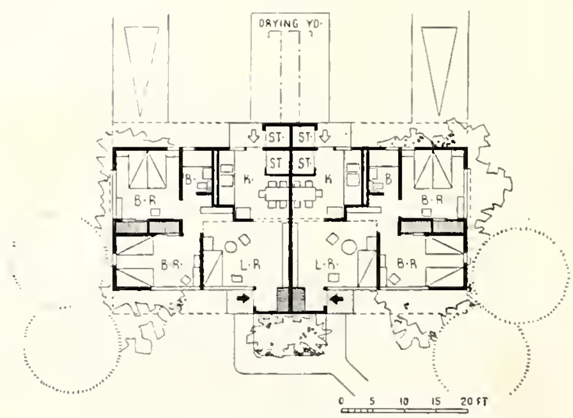
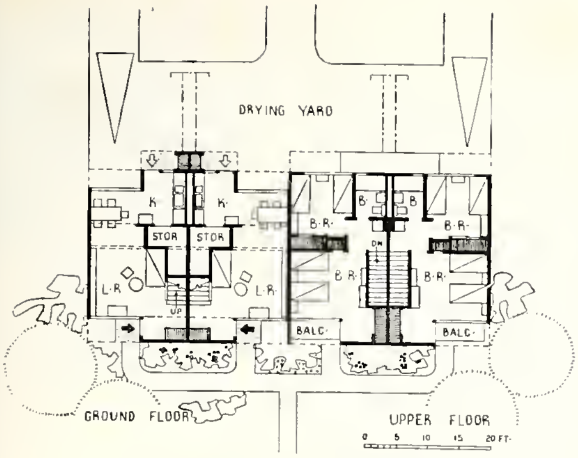
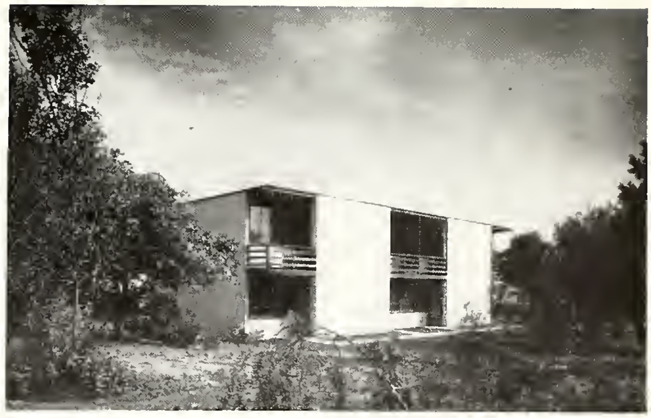


Fig. 53. Channel Heights Housing Project, Calif. Richard J. Neutra, architect. This project contains a variety of units in one and two story buildings. The treatment of the exterior is unusually successful in avoiding the monotonous stereotyped appearance usually associated with low-cost housing developments.









Possible reductions in cost may be derived from a reduction in Federal taxes and a willingness of building operators to accept lower returns, although the prospect of either of these is slight. The allowance for vacancies may be reduced through elimination of vacancies by making units more desirable. There seems to be little likelihood of reduction in operating costs, except by the elimination of necessary services or by shifting costs to the tenant, which is not a real saving to him. Local real estate taxes show no signs of reduction and in some places there is talk of increasing them. Building costs at the present time are rapidly increasing, and it will probably be a long time before they are reduced. Changes in existing building codes allowing the use of new materials and construction methods will help to a limited extent (see discussion of costs in Chapter 1). Among such changes may be noted:

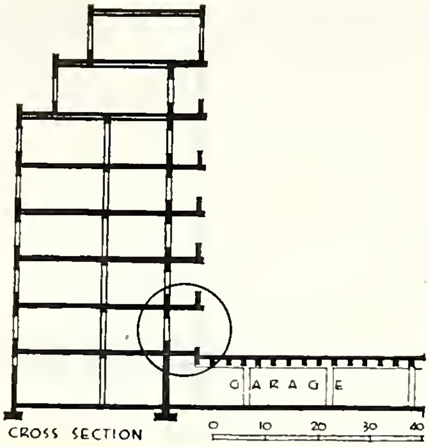
1. Use of panels of minimum thickness to replace masonry walls on buildings of skeleton construction.

2. Use of interior baths, mechanically ventilated, for multi-story buildings.

3. Uniformity of regulations governing structural requirements, which vary widely in different states.

The most promising line of inquiry, however, lies in the direction of changes in financing procedure and graded real estate taxes, or periods of tax exemption. Urban redevelopment bills have been introduced in many states, and various other schemes of this type have been proposed by writers on the subject. A detailed discussion of these schemes is beyond the scope of this book.[1]

[1] See New Cities for Old by Louis Justement, F.A.I.A., McGraw-Hill Book Co., Inc., 1946, and American Housing, The Program by the Housing Committee, Chapter 12, The Twentieth Century Fund, 1944.



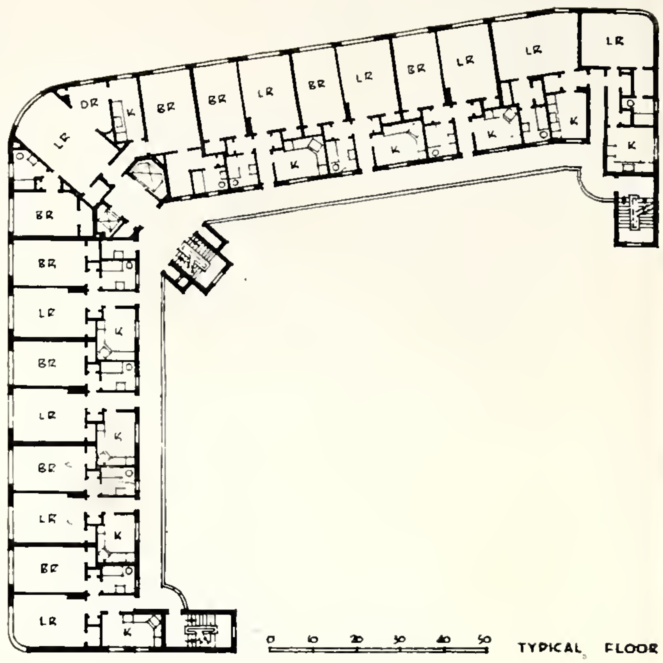


Fig. 54. Shangri-la Apartments, Santa Monica, Calif., William E. Foster, architect. A balcony entrance type apartment building containing 62 units. The principal advantage of this type of plan is that all units can be oriented to take advantage of the best angles of sunlight and the best views. Note that only entrance foyers, kitchens, and baths face on the entrance balcony. The garage, below the garden court, has a capacity of 62 cars. The entire building is of reinforced concrete.

The standards of design of units for low rental projects differ from those used in moderate or high rental projects, because experience, as revealed in several surveys of such projects, shows that different space relationships are necessary due to different living requirements and due to the fact that through economic pressure such units usually have a higher number of occupants per room than in moderate or high rental buildings. While this increased density is not a desirable feature, it is a condition that does exist and which must be faced in considering the design of the apartments. This condition will be discussed further under the heading "Unit Plans."

Building Plan Types

Buildings in general may be divided into three catagories, according to the means used for access to apartment units:

1. **Corridor type**

2. **Group type**

3. **Balcony entrance type**

The corridor type building, as the name implies, is characterized by corridors of varying length giving access, as a rule, to more than 5 apartments per floor. Over the past several years it has been customary to condemn this type of plan as being uneconomical from a viewpoint both of construction and maintenance. However, as has already been discussed under the heading of "Suburban Apartments," I do not think that this conclusion is borne out by actual experience, and this type of plan if properly carried out has many real advantages.

Firstly, on moderate sized lots, where limitation of space will not permit a group

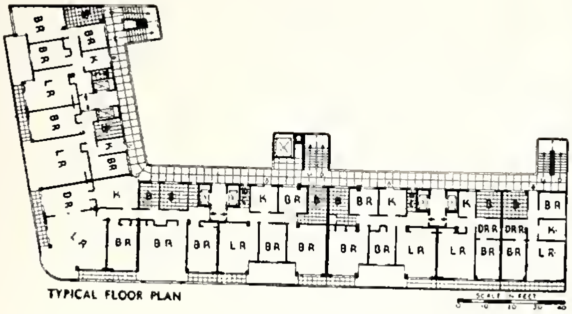


Fig. 55. Embassy Court Apartments, Brighton, England, Wells Coates, architect A balcony entrance type plan with all main rooms facing an ocean view. With the number of bedrooms required per unit it was impossible to avoid having some bedrooms open onto the balcony approach with a resultant loss of privacy.

plan to be used to advantage, and secondly in multi-story buildings, where it provides the only economical method of using elevators in an efficient manner.

The group type of plan, in which a limited number of units are grouped about a single stair (usually from two to four units per stair) is appropriate for use in 2 and 3 story buildings. Its advantages and disadvantages have already been discussed under the heading of "Suburban Apartments."

The third type of building plan, the balcony type, utilizes a corridor, generally open to the outside of the building along one side of the units only. This type has been used on a number of European buildings, but only to a very limited extent in the United States (Figs. 54, 55).

A number of examples of this type of building will be found in *The Modern Flat* by F.R.S. Yorke and Frederick Gibberd. The proponents of this type of plan claim that it is more economical in construction than the central corridor type, but I have seen no evidence to support this claim. In inclement climates such open corridors would present a maintenance problem from the point of view of disposal of snow and ice, unless equipped with some form of heating panels which would melt it as rapidly as it was formed. To obtain the necessary privacy and quiet in the units of this type of building, living and sleeping rooms must be isolated from the corridor, else windows opening on the corridor would admit the occupants to the views of passers-by and would receive all the noise of footsteps and conversation in the corridor.

Thus the only rooms which can face the corridor are kitchens and baths, which proves a severe limitation in planning, especially if large units with more than one bedroom are required. As for economy of circulation, such buildings, while un-

doubtedly more economical than the grouped type, require twice as much corridor per unit as the central corridor type. They have the rather dubious advantage of through ventilation, but this, as has already been pointed out, lacks the efficiency and cooling effect of mechanical ventilation. From the point of view of exterior appearance, they can be made quite attractive, presenting a very different aspect, on the corridor side at least, from the usual straight wall used in other types of buildings.

Influence of Zoning Laws on Planning

The type of zoning law governing the project has a great deal to do with the type of building produced and the planning method used to produce it. For instance, in the District of Columbia the zoning law specifies the sizes of yards and courts, the amount of land that may be covered, the number of stories, and the over-all building height permitted. Usually, the amount of land that it is permitted to cover is considerably in excess of what can actually be used inside of the lines drawn to define the required side and rear yards. The net result is that the planning process becomes very much like working a jig saw puzzle, attempting to fit into the building shape, as determined by the shape of the lot, as many rooms as possible.

On the other hand, in the surrounding counties in Virginia and Maryland the zoning law works in a very different manner. There a certain amount of lot per apartment unit is required. In Montgomery County, Maryland, for instance, it is 625 square feet per unit. By simply dividing the lot area by this figure, the maximum number of units permitted is at once settled, and the problem then becomes the more interesting and more sensible one of arranging the permitted units on the site in the best and most economical manner. This method of zoning also gives a definite limit to population density in any given area, which the method employed in the District does not, because in the District's method of limiting only building bulk no account is taken of the number of apartments which may be incorporated in the building. In Arlington County, Virginia, this method is carried still further by varying the lot size requirements in accordance with the number of rooms in the apartment units.

The remedy for a faulty zoning law that has been in existence for a long time and has permitted overcrowding of lots is far from being a simple one. Over a long period of time many buildings will have been built in conformity with the law and land values will have been established in accordance with its standards. An abrupt change in allowable density will work a great hardship on the owners of the land who have bought ground in good faith at a price based on its use value at the time of purchase. As has been pointed out in an earlier chapter, the price that will be paid for the ground for apartment building use is dependent on the revenue to be obtained from the building which may be placed upon it. Also, such a change will place in an unfairly stronger competitive position old buildings which were built under less restrictive laws.

If there is to be an emphasis one way or another it should be toward the encouragement of new and better buildings rather than toward making it more profitable to hold onto old and dilapidated ones. This is a situation that seems not to have been given attention in the past and it is one that is worthy of serious and careful study. A good zoning law should achieve its purpose of providing adequate open spaces to give light and air, and of controlling population density and type of occupancy, and at the same time give a maximum amount of freedom to the designer to work out the best possible building plan in conformity with these aims. After having

planned many buildings under both of the above described types of law, I believe the type that fixes population density in relation to lot area gives far better results than that which merely specifies building bulk. A part of the answer to this increased freedom of planning arrangement lies in the fact that the permitted density of population is in general considerably less in Maryland and Virginia than in the District of Columbia. However, under any zoning law conditions, it is unquestionably better to control population density than to have rigid limitations as to the bulk of building permitted. Limitation of population density without limitation of building height permits a reduction in ground coverage with its accompanying advantages as previously discussed.

Types of Units

Apartment units should be designed to provide complete living facilities for the type of tenant for whom they are intended. Consideration should be given to providing proper space circulation and equipment for all the manifold activities of family life which have been listed in Chapter 1. The needs and living habits of different classes of occupancy cause a variation in the size and arrangement of the spaces necessary to satisfy these needs, and much study and research yet remains to be done along the line of inquiry into individual living habits and preferences. It must be remembered, too, that the problem of designing for tenants' needs and desires is very different from that of adjusting to their ability to pay rent.

Surveys which have been made indicate much dissatisfaction on the part of renters of low rent projects. Most of their criticisms being directed towards:

1. Lack of adequate closet space. For reasons of economy storage space is generally kept to a minimum in low rent projects. This lack is a source of great inconvenience to the tenants since room sizes are also kept to a minimum and it is not feasible for the tenant to supplement the meager closet space provided by using chests or wardrobes. This deficiency makes it very difficult if not impossible to keep the quarters in a neat and orderly condition.

2. Kitchens too small. Most occupants of low rent units say that they use the kitchen as the main household center. It is used not only for food preparation but also for eating, laundry work, ironing, sewing, and frequently in the evenings as a place to read or relax.

3. Poor room relationships. Due to the high density of population per room in low rent projects, circulation should be arranged so that it is possible to use the living room for sleeping purposes. Adequate standards of privacy require that the bathroom be accessible without passing through any other room, and it is preferable that all sleeping rooms be reached from the entrance foyer without passing through the living room.

A survey conducted by the Federal Public Housing Authority published under the title "The Livability Problems of 1,000 Families," NHA, FPHA, 1945, showed in low rent projects:

80% of the families have children

50% of the children are under four years old

50% of the children are of school age

89% of families eat in the kitchen most of the time

25% of the families entertain in the kitchen

32% of the children study in the kitchen

52% of the children play in the kitchen

32% of the families dry clothes in the kitchen

82% do ironing in the kitchen

27% sew in the kitchen

435 families out of the 1,000 own sewing machines

50% do laundry more than once a week

3% eat in the living room regularly

5% eat in the living room occasionally

80% of families with children use the living room for children's play

38% of families with children use living room for study

Room size, location of radiators, windows, and doors should be studied in relation to room usage. Bedrooms must double as places for work, study, pursuit of hobbies, and relaxation; living rooms must frequently be used for sleeping and dining as well as performing the usual living room functions, and in many cases kitchens must also accommodate practically every function except that of sleeping.

The unit plans of moderate and high rent apartments will differ in many respects from those used in low rent projects, due to the fact that a much less intensive use of space is necessary. This permits the development of more open plans giving an added air of spaciousness. Dining space can be thrown open into the living room, giving a greatly increased air of spaciousness and confining cooking odors and heat to the kitchen. The kitchen itself can be somewhat smaller as it is used only as a work space. Circulation through the living room is not objectionable as it is not generally used for sleeping purposes, but where such circulation is used it should be studied in relation to furniture placement and room use so as not to interfere with proper grouping of furniture.

Bathrooms should never open directly from a bedroom unless more than one bathroom is provided, and then, one bathroom should always open on a hall accessible to each room without going through any other room except the living room. Closet space should be generous. At least one large closet for each bedroom, two wherever possible, a coat closet near the entrance, and a linen closet in the hall near the bathroom are the minimum that should be provided. Additional closets for general storage and small closets in the bathrooms for storage of articles too bulky for the usual medicine cabinets are very useful and greatly appreciated by tenants. Built-in

chests of drawers, good shelf arrangements, and closet fixtures are attractive and useful features that should be included wherever possible.

Luxury apartments, as the name implies, should really go the limit in the way of providing superb living quarters. I do not believe that the usual method of merely adding on more rooms accomplishes this result. Much more in the way of imagination and ingenuity is needed. The study made by the Serge Chermayeff group and published in *The Architectural Forum* for May 1943 is an indication of the possibilities (Fig. 56). In this scheme, interest and spaciousness are gained by arranging each unit on two or three levels, all apartments have large balconies and living areas arranged to take advantage of views and to receive sunlight. The services and amenities provided, the general character of the units, and their arrangement as suggested on garden sites would provide living quarters of great attractiveness. The units as presented are of moderate size, as the scheme was designed for a moderate rental building, but a further development of planning of this type applied to luxury-type apartments would, I believe, provide luxury apartments far superior to those which have so far been built.

One element in planning luxury apartments not found in other units, is the necessity for providing servants' rooms. The number of servants' rooms and baths to be provided will vary considerably with the size and degree of luxury of the apartment, some units having only one such room, some having as many as ten or twelve. Entrance to the servants' quarters should be through a separate service entrance, which may also serve the kitchen and other service areas.

Unit Requirements

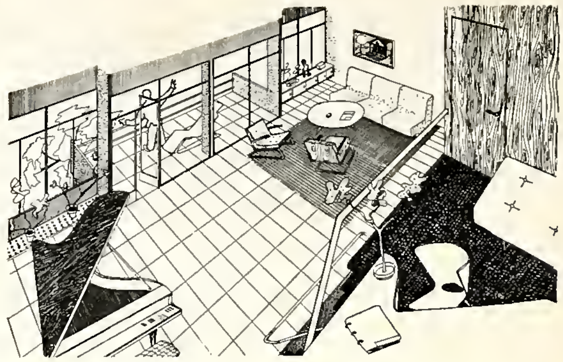
TABLE OF SUGGESTED MINIMUM ROOM SIZES FOR LOW RENT PROJECTS

Living room	11 × 15	165 sq. ft.
Main bed room	10 × 15	150 sq. ft.
Additional bedrooms	9 × 12	108 sq. ft.
Kitchens	7 × 9	63 sq. ft.

It should be noted that these sizes are suggested as minimum, not as ideal sizes. Kitchens to be really adequate for eating and laundry work, etc., in addition to food preparation, should contain from 100 to 150 sq. ft. of floor space. Kitchen equipment should be arranged as compactly as possible freeing the rest of the room for other purposes. Bathrooms are usually made as small as possible to accommodate the required fixtures, but where feasible, extra space in the bathrooms with facilities for light laundry work will help relieve the necessity for doing this work in the kitchen.

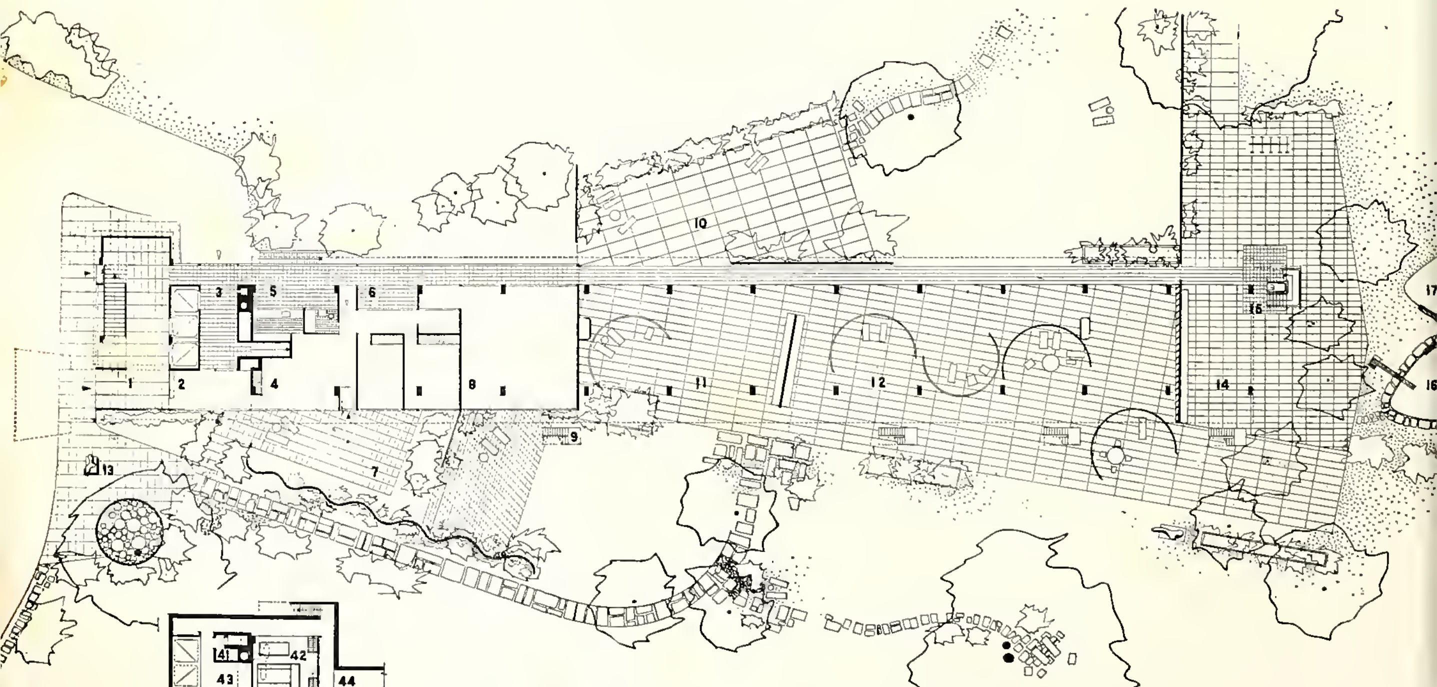
Standard types of inexpensive furniture now on the market do not function efficiently in small apartments. Properly designed and constructed inexpensive furniture, scaled down to the size of the rooms would prove a tremendous help. Such items as double decker bunks and combination bureau-desks would leave more space clear for other activities and for additional storage units to supplement the usually inadequate closet space. Attractively designed studio couches could be combined with storage units for living room use.

An article published in the *Octagon*, The Journal of the American Institute of Architects, for October and November 1941, entitled "Notes on the Design and Construction of the Dwelling Unit for the Low-Income Family" by Elisabeth Coit, A.I.A. presented much interesting and useful information on the subject of units for low



VIEW FROM NORTH—WEST

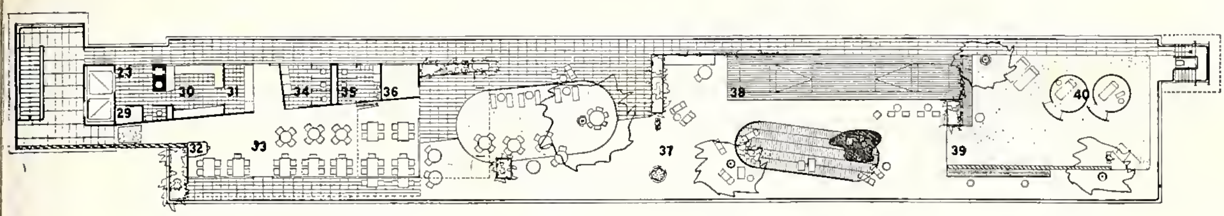
Fig. 56. Park Apartments designed by the Serge Chermayeff group, New York. Peter Blach, Serge Chermayeff, Abel Sorensen, collaborators; Narman Fletcher, Henry Hebbelin.



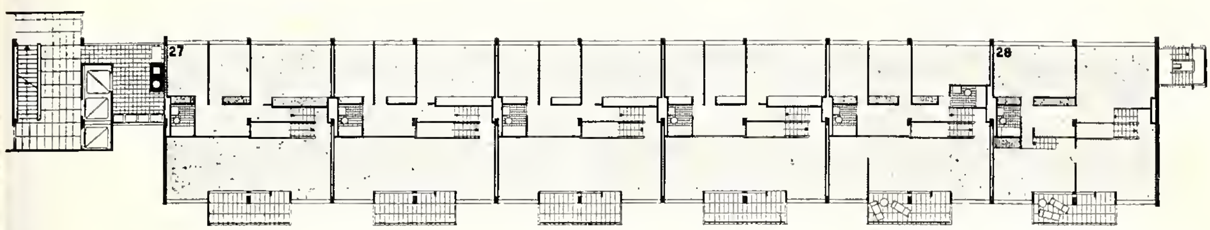
GROUND FLOOR AND BASEMENT

KEY TO PLANS

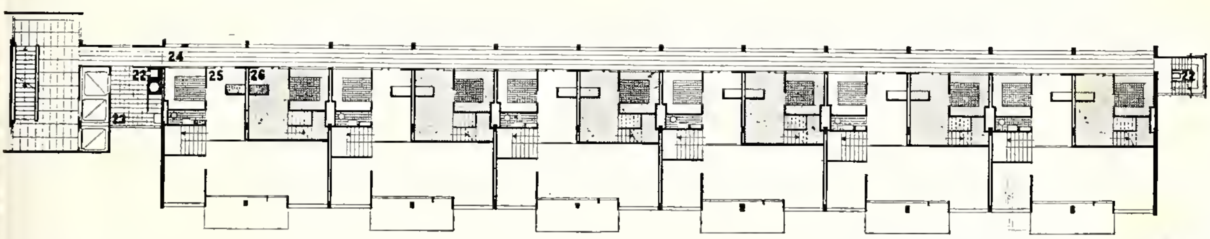
1. Main entrance
2. Office
3. Service entrance
4. Manager's apartment
5. Baby carriages
6. Bicycles
7. Manager's garden
8. Tenant's storage
9. Stairs from 2nd floor apartments
10. Eastern terrace
11. Covered terrace
12. Wind screens
13. Sculpture
14. Children's play area
15. Escape stair
16. Paddling pool
17. Sand pit
18. Hall
19. Laundry
20. Lower level of Apt. 1
21. Balcony
22. Refuse chutes
23. Service
24. Corridor
25. Corridor level of Apt. 1
26. Corridor level of Apt. 2
27. Upper level of Apt. 2, standard 3-bedroom plan
28. Upper level of Apt. 2, variations
29. Stores and staff toilet
30. Kitchen
31. Serving counter
32. Film projection booth
33. Restaurant



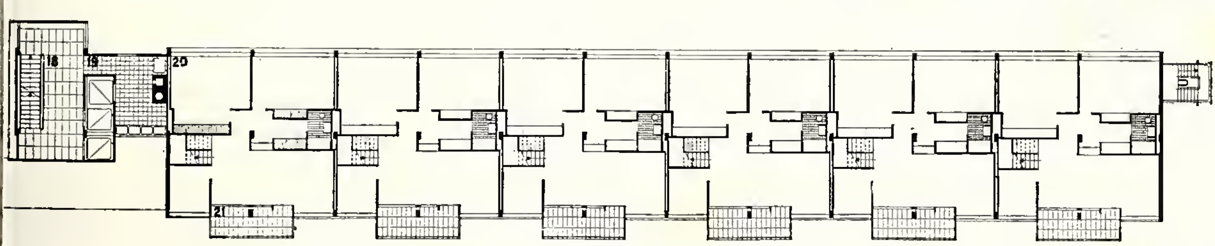
ROOF



LEVEL D OF BASIC SECTION (1), APARTMENT II.

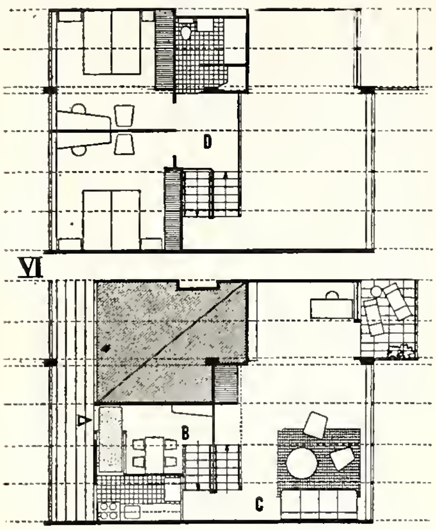


LEVEL B OF BASIC SECTION (1), APARTMENTS I. and II.

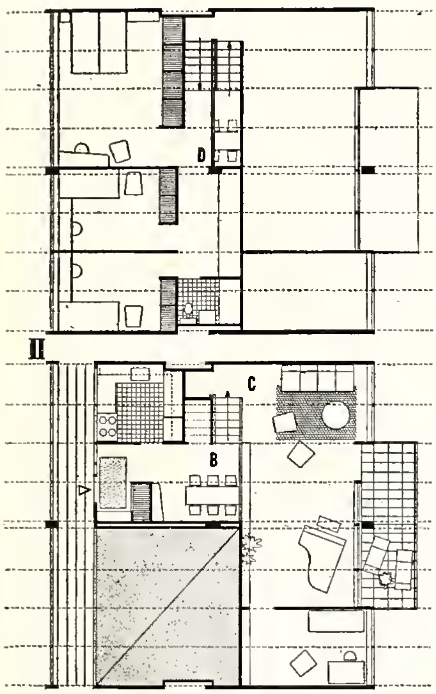


LEVEL A OF BASIC SECTION (1), APARTMENT I.

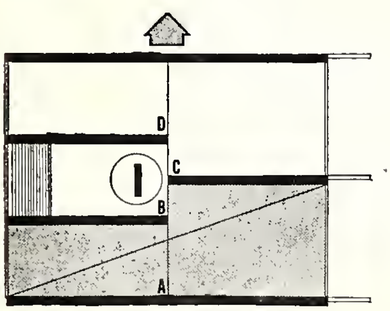
34. Women's toilet
35. Men's toilet
36. Chair storage
37. Roof Garden
38. Shuffle board
39. Sunbathing lawn
40. Wind screens
41. Incinerator
42. Heater and boiler room
43. Ducts and electric control
44. Trench

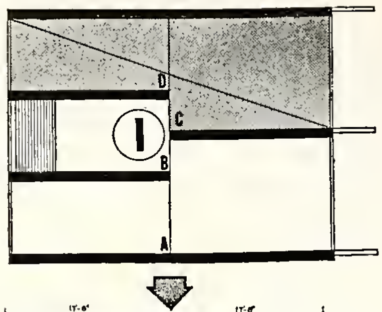


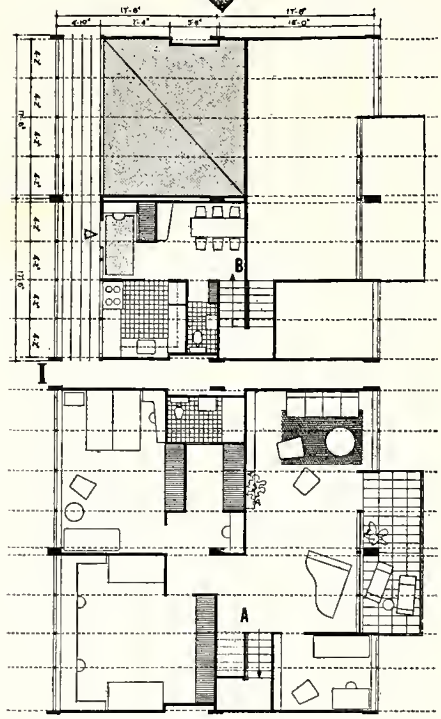
1½ BAYS, ON THREE LEVELS



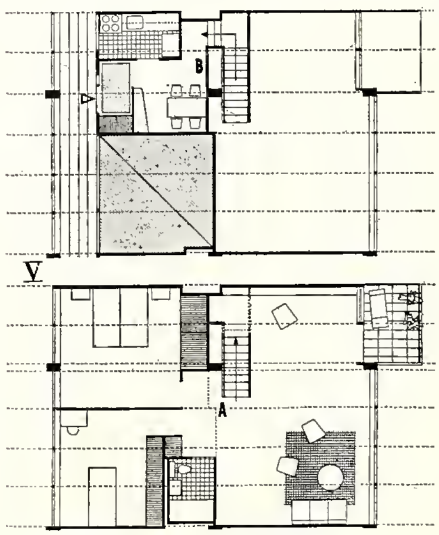
2 BAYS, ON THREE LEVELS



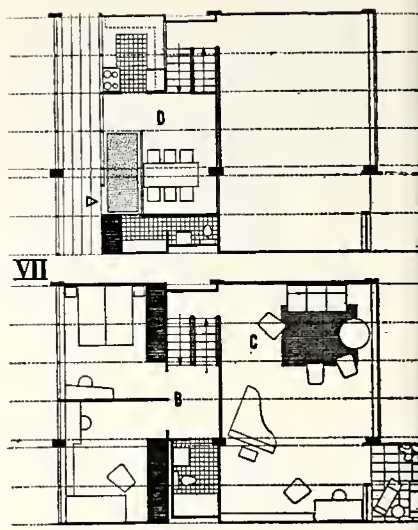




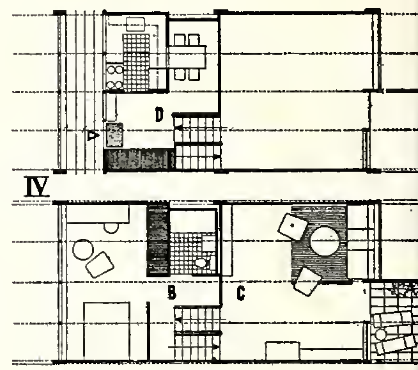
2 BAYS, ON TWO LEVELS



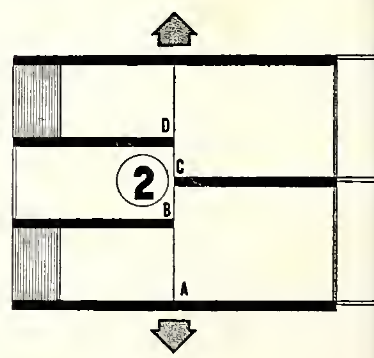
1½ BAYS, ON TWO LEVELS

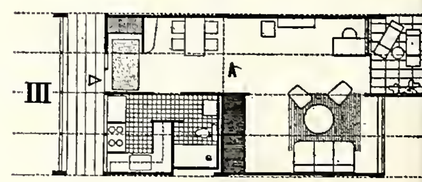


1½ BAYS; ON THREE LEVELS



1 BAY, ON THREE LEVELS





1 BAY, ON ONE LEVEL

All apartments shown of this group fit into one or another of two basic sections. The principal difference between these sections is that one has a single corridor while the other has two. Section 1 (single corridor) is used for the larger apartments; section 2, used for small apartments, requires two corridors to serve the increased number of tenants and to get a more even distribution of traffic. The left-hand column shows the plans of two apartments which fit into the upper half of section 1. Both are arranged on 3 levels. The center column shows the apartments which fit into the lower half of section 1. The apartments in section 2 (right-hand column) are one- and two-bedroom units on the 3 upper levels, and an efficiency apartment with a bed-living room on the lowest level.

rental occupancy. This article was also the subject of a graphic presentation published in the *Architectural Record* for December 1939.

TABLE OF SUGGESTED MINIMUM ROOM SIZES FOR MODERATE RENT PROJECTS

Living room	12 × 18	216 sq. ft. to	13 × 20	260 sq. ft.
Main bedroom	11 × 15	165 sq. ft. to	12 × 17	204 sq. ft.
Add. bedrooms	9 × 13	117 sq. ft. to	11 × 15	165 sq. ft.
Dinettes	7 × 8	56 sq. ft. to	7 × 12	84 sq. ft.
Kitchens	7 × 7	49 sq. ft. to	7.5 × 10	75 sq. ft.

The range of sizes indicated here is usually used in units renting in the Washington, D.C., area from about $22 per room to about $30 per room, which is considered moderate rental in this locality. These sizes give adequate space for comfortable living when units are properly arranged. Bathroom sizes are generally held to a minimum. Entrance foyers should be adequate but not overly large, ranging from a minimum of about 16 square feet to a maximum of 40 square feet. Larger foyers and halls of excessive length are generally an indication of wasteful and inefficient planning.

Sizes of principal rooms in luxury type units can range on up to anything desired, at the discretion of the designer. However, it should be emphasized again that mere room size and number of rooms do not make a real luxury unit. This depends on the air of spaciousness and livability provided and the adequacy of circulation. Provision must be made both for entertainment, usually on a fairly large scale, and for privacy and relaxation when desired. Servants' quarters should be kept to a minimum size, and should be studied carefully so as to provide adequate space for furniture.

Storage Facilities

In all apartment units facilities for storage are of prime importance. In addition to the minimum amount of closet space in the units themselves, it is necessary to provide additional storage space for bulky articles, or for things having seasonal use. This space is usually provided in the basement and care must be exercised to see that it is properly ventilated and dry. The space may be arranged as a series of individual cubicles generally separated by partitions of chicken wire, to allow air circulation, or as an open room, in which case the room must be kept locked at all times and access permitted only in the presence of an attendant. All articles put into a general room should be tagged with the owner's name, as it has been found by experience that people frequently fill their allotted space with bulky articles and move away leaving them behind. This leaves the management in a few years with enormous piles of junk on its hands and with no way of identifying the owners. Getting rid of such accumulations sometimes presents a serious problem. It should be made one of the duties of the building employees to see to it that tenants take their stored articles with them when they leave. As to sizes, for individual compartments a size of about 4 × 6 should be adequate, for general storage rooms a somewhat smaller space allowance may be made, but the amount of space that may be used by each tenant must be limited by house rules and care must be taken to see that these limits are observed.

Within the units, closet space must be carefully designed to accommodate the articles for which it is intended, giving due attention to proper clearances and accessibility. Coat closets near apartment entrances should be 2 feet deep, minimum, and 4 to 5 feet long, with hanging pole and two shelves. Bedroom closets should have the same depth and should have a minimum length of 4 feet per person.

Minimum equipment is hanging pole and two shelves. Linen closets should not exceed 2 feet in depth and should be about 4 feet wide, not less than 6 shelves should be provided, and where possible in the budget, built-in drawers and sliding trays will prove a useful addition. Height of hanging poles is usually about 5 feet 6 inches with the first shelf 4 inches above the pole. The second shelf should be 10 inches above the first. Hook strips, if used, should have hooks at the same height as the pole spaced not less than 6 inches apart. The sizes and equipment mentioned above are minimum and built-in equipment in the form of additional shelves, drawers, shoe racks, etc., as shown in the accompanying sketches, will greatly increase their utility (Figs. 57, 58, 59).

Additional closets for the accommodation of luggage, card tables, and the innumerable other articles used by the average family should be included whenever possible. A small closet near the kitchen for the storage of cleaning materials and equipment, extra pots and pans, and supplies of canned goods is a welcome supplement to the cabinets provided in the kitchen. The so-called broom cabinets usually provided do not give adequate space for mops, vacuum cleaners, brooms, etc., and the shelf space available in the regular kitchen cabinets is usually inadequate for the storage requirements of the average family for the innumerable articles frequently used, such as food mixers, grinders, toasters, waffle irons, extra dishes, glasses, pots and pans, etc.

Individual Room Requirements: Kitchens

The more or less enforced use of kitchens for other purposes than meal preparation in low-rent projects has been discussed above, and where they are to be so used due to lack of proper facilities elsewhere in the unit, space for these other activities must be provided in them. In buildings of other types the reduction of kitchens to a minimum size is not a disadvantage when they are properly planned, and this reduction leaves more space for living activities in the balance of the unit. The kitchen's location in the unit plan is determined by its relation to the dining space and the apartment entrance or in luxury units in relation to the service entrance, which is necessary for privacy when servants are employed.

The kitchen equipment layout is determined by the sequence of operations to be followed in the work performed and by provisions for adequate storage of the materials and utensils used. The kitchen must serve for:

1. Food preparation

2. Cooking

3. Serving

4. Dish washing

5. Storage

6. Dining or other incidental uses as discussed above.

The essential kitchen equipment is:

1. Range

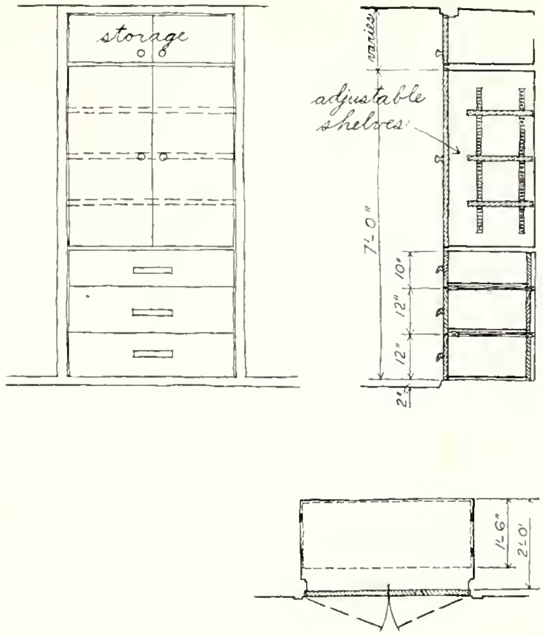
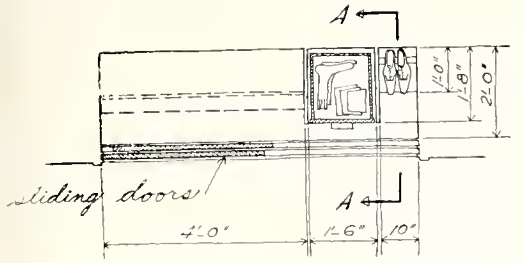


Fig. 57.



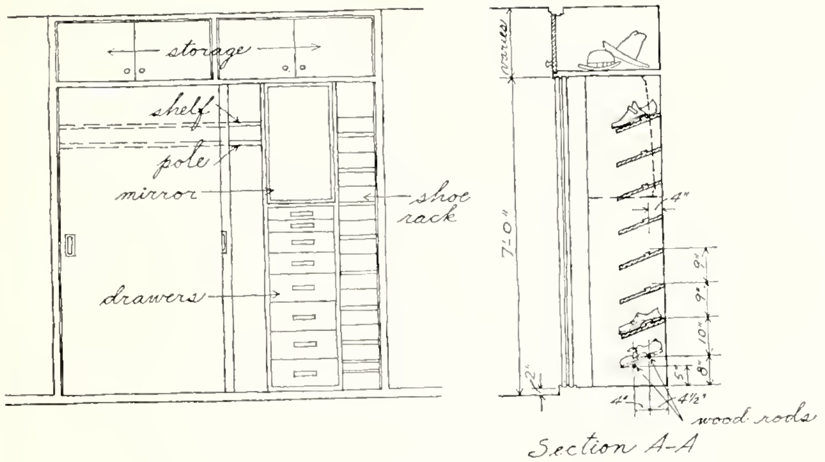
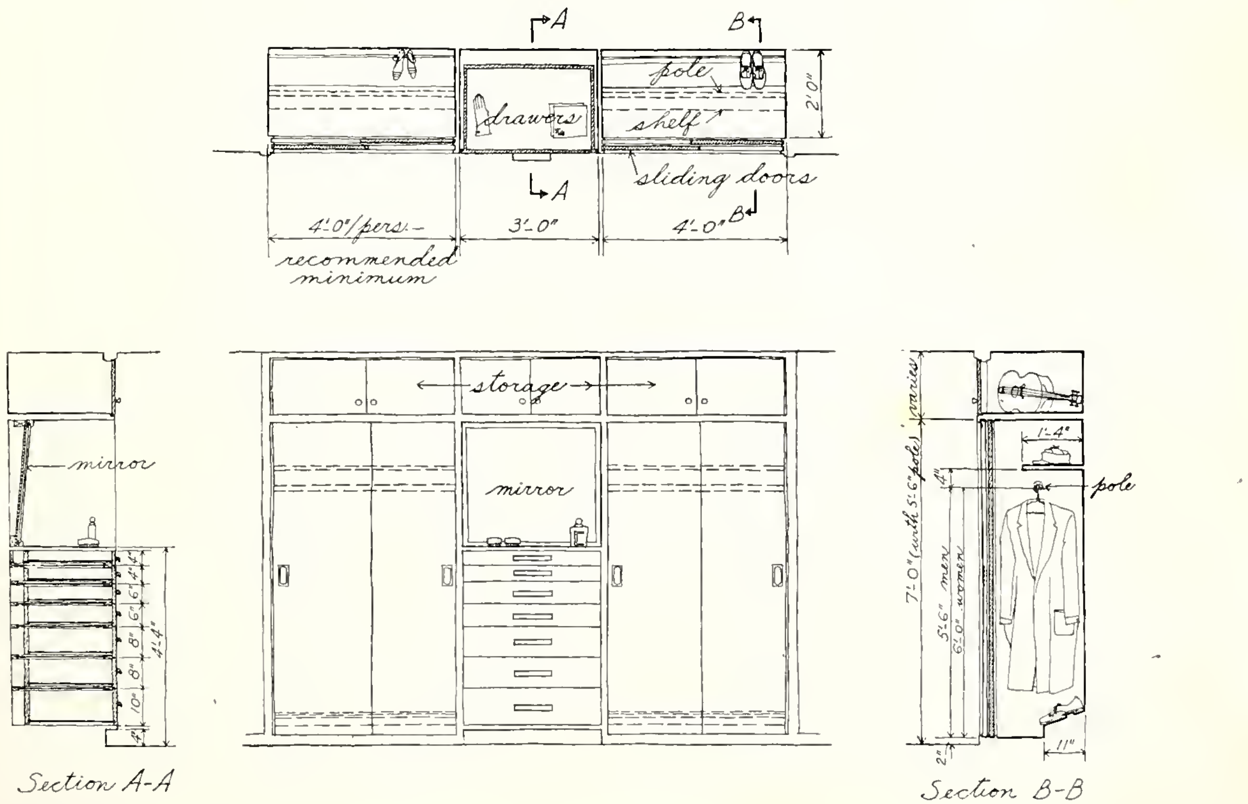
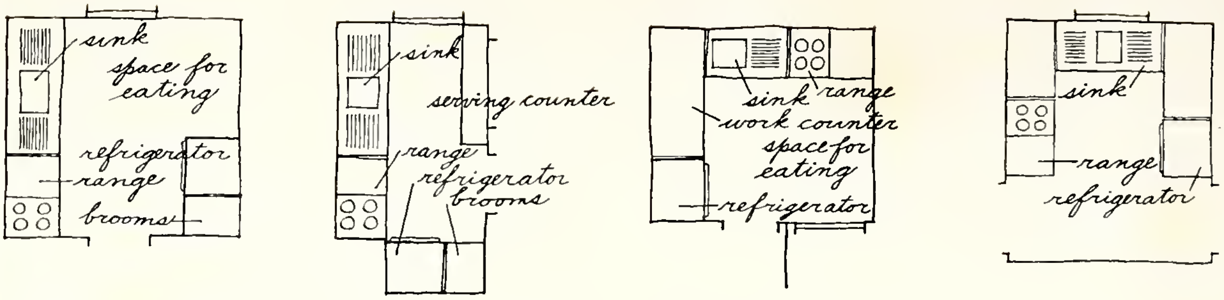


Fig. 58.

Fig. 59.





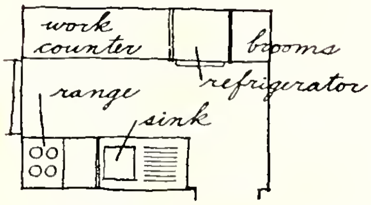


Fig. 60.

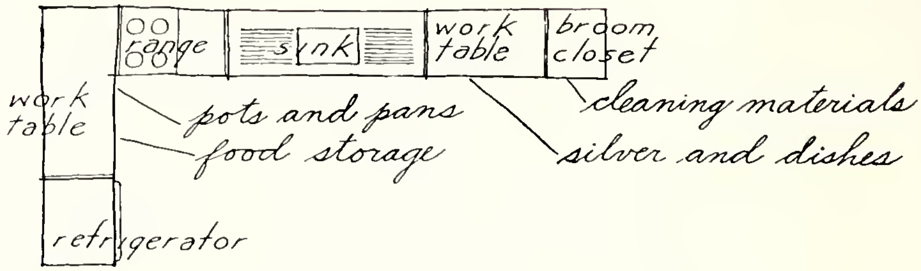


Fig. 61.

2. Sink

3. Work surfaces

4. Refrigerator

5. Storage units for food, utensils, cleaning materials.

FPHA regulations call for a minimum of 30 square feet of shelving in kitchens of apartments occupied by two persons, with an additional 3 square feet for each additional occupant. Most moderate rental units provide about 50 square feet per unit. These amounts are an absolute minimum and more should be provided where possible. When the budget will stand the cost, the addition of dish washers, garbage disposal units, frozen food lockers, and other modern kitchen aids should be considered. A serving hatch between the kitchen and dining space is a great aid to the easy serving of meals and clearing of the table after meals.

Kitchens in general use today show three main types of arrangement: strip, "L" and "U" (Fig. 60). Efficiency studies show that most kitchen arrangements cause a great many unnecessary steps for the preparation of meals and the cleaning up after meals due to location of equipment without regard to the usual sequence of operations and lack of storage space in proper relation to the equipment with which it is used. The ideal arrangement so far as sequence of operation and step-saving is concerned is as shown in Fig. 61. The sequence starts at one end with the refrigerator for storage of perishables and cabinets for the storage of dry foods, work space for food preparation is close at hand along with storage space for pots, pans, and other utensils. The range is located in convenient conjunction with the sink, which is used for food preparation and for cleaning up afterwards. Silver

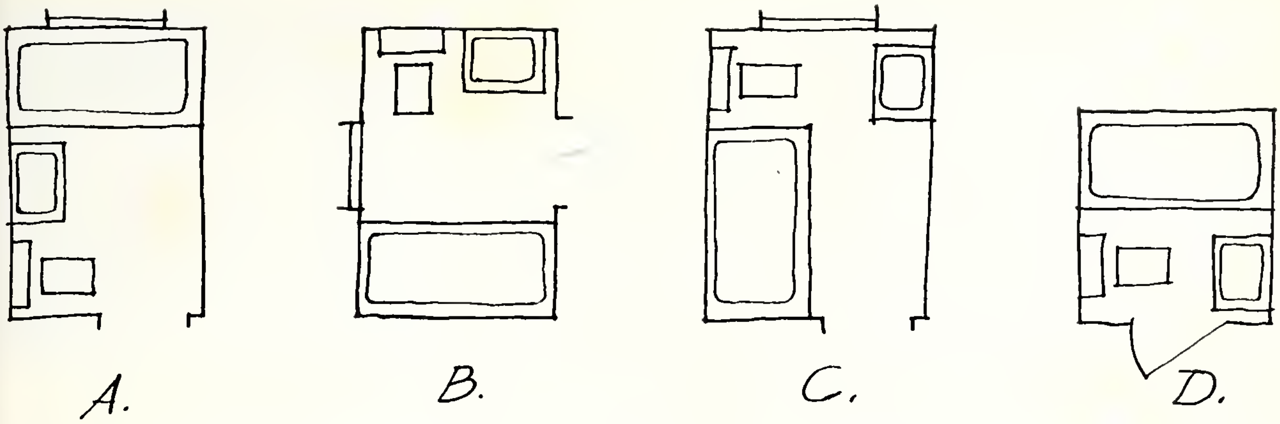


Fig. 62.

and dish storage is next to the sink with a work top useful for serving and cleaning-up operations. General cleaning materials are located adjacent to this space.

Design of kitchen equipment in general suffers from two principal defects: 1. too great a concentration upon what has come to be regarded as conventional appearance, and 2, by the fact that equipment is generally an assemblage of units made by different manufacturers with little or no correlation of design. Integration of sinks, ranges, refrigerators, and cabinets can have many benefits, among them elimination of unsightly and unsanitary cracks and crevices, saving of valuable space, and more functional arrangements of equipment.

Good ideas in this direction may be gained from an inspection of restaurant equipment which often incorporates such items as built-in cutting boards fitted with their own faucets for cleaning, direct chutes from work tops to garbage containers, etc. Locations for freezing chests, cold storage compartments, and ice trays should be built into cabinets in their most convenient locations instead of being in one movable unit as at present. Ovens and burners or heating elements should also be built in instead of having the range as a separate piece of equipment. Designs of kitchen units incorporating these features have been published from time to time and it is to be hoped that they will shortly be actually available for use.

Strip kitchens opening directly into living rooms should be used only when absolutely unavoidable. Where mechanically ventilated kitchens are permitted, small inside kitchens separated from the living room can frequently be incorporated in the plans at little extra expense. Whenever possible some space for eating should be provided in kitchens, even though dining space is provided elsewhere, as this space is useful for minor meals, snacks (Fig. 60), and other appropriate activities, such as ironing, studying, extra serving space when entertaining, etc.

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Fig. 63 (upper left). Living and dining space in the apartment building at 2720 Wisconsin Avenue, Washington, D. C. Joseph H. Abel, architect.

Horydczak

Horydczak

Fig. 64. Interiors in the building at 2121 Virginia Avenue, Washington, D. C. Joseph H. Abel, architect. The furniture in this apartment was specially designed and made by Arundel Clark, Ltd., of New York City. Note the built-in storage space and book case beneath the window in the bedroom. The twin beds are hinged to the headboard so that they may be easily rolled apart for ease in bed making.

Baths

Bathrooms are usually arranged in the minimum space which will accommodate the required fixtures. The fixture arrangement generally used depends on the location of the door as indicated in Figs. 62A, B, C, D. When fixtures are arranged as in Fig. 62A, the window is usually located over the tub. This location has in general proven satisfactory. The location of the lavatory between the tub and the WC is better than locating the lavatory in the corner as it gives some elbow room to the user. The arrangement shown in Fig. 62D, while it is the most compact, is not to be preferred because it is too cramped for comfortable use and the door must open outwards which is an objectionable feature. The arrangement shown in Fig. 62C is good but requires slightly more space than either A or B.

Usual practice is to provide a medicine cabinet with a mirror door over the lavatory and a shower over the tub. Where more than one bath is incorporated in a unit the second bath usually has a stall shower instead of a tub. Accessories usually built into the walls should be as a minimum, two towel bars, paperholder, soap dish, toothbrush holder and tumbler holder at lavatory, and combination grab bar and soap holder at tub.

The most usual floor finish is ceramic tile, with a glazed tile wainscot about four feet high on the walls, and 6 feet 6 inches high around tub and shower. Linoleum floors and wainscots have been used to some extent. They are less expensive to install than tile, present a very attractive appearance, and are perhaps a little easier to keep clean. In some cases wainscots have been omitted except around tubs and showers. All plastered surfaces should have a gloss enamel finish. Structural glass, enameled steel, and plastic surfaced wall boards have also been used satisfactorily as wainscot materials. Where colored finishing materials are used care should be exercised to select soft and harmonious colors as garish, bizarre effects soon grow tiresome. All exposed metal work should have a chrome finish as it is the easiest to keep clean and to maintain.

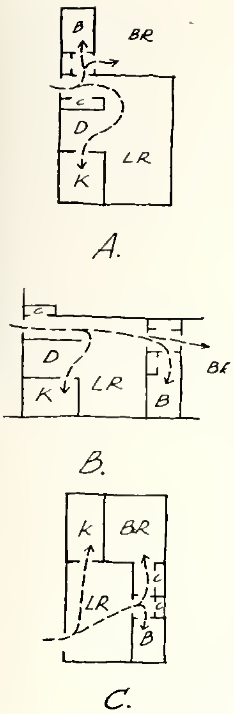

Fig. 65.

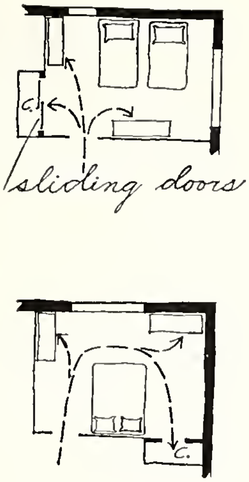

Fig. 67.

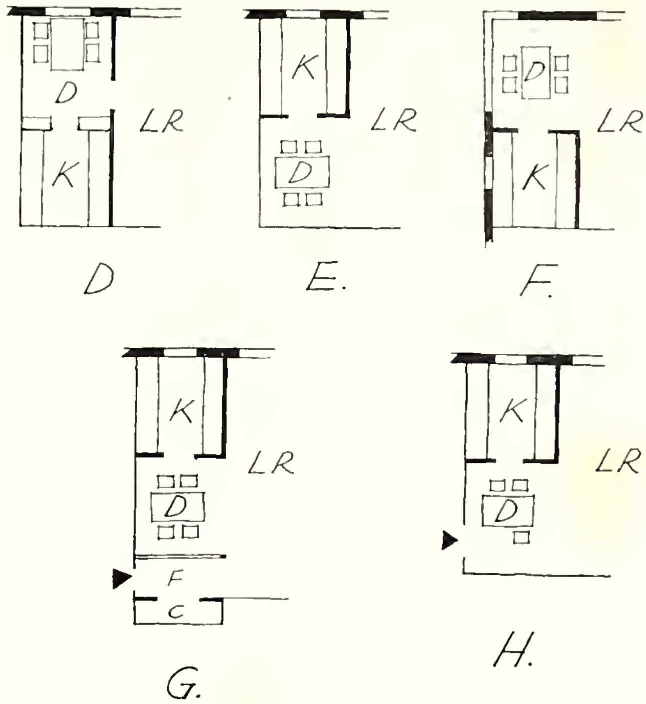

Fig. 66.

The greatest defect in bathroom design is the usual lack of sufficient storage space. Built-in cabinets under or on either side of the lavatory or a small closet would be a good addition to the usual bathroom. Medicine cabinets are too small for many articles frequently used and ventilated space for a soiled linen hamper is also needed. Provision of a suitable device for drying light laundry would be appreciated in many cases.

All bathroom lights should be controlled by wall switches; lights should be located over or preferably on either side of the mirror for use in shaving, etc., and an electric outlet should be conveniently located to permit use of electric shavers and curling irons. Location of baths back to back or adjacent to kitchens permits some economy in cost of piping used, but not enough to cause this arrangement to be a controlling feature of the unit design. Proper location with respect to use and circulation should be the controlling element.

Living and Dining Space

The living room needs an appearance of spaciousness and space enough to allow for freedom of movement. A width of eleven feet should be considered an absolute minimum, and a minimum of twelve feet is to be preferred. The shape of the room is as important as its area; its length should not exceed twice its width. Very narrow long rooms do not have an agreeable appearance and with windows as usually located at the narrow end light distribution is poor if this proportion is exceeded. The location in plan should allow for a maximum of sunlight penetration and good outlook.

The modern trend toward continuity of windows, omitting intervening piers, is of value in obtaining better distribution of light and adding to the feeling of spaciousness. (Figs. 63, 64). Sill height for conventional windows is usually about 2 feet 6 inches to allow for radiators and furniture placement. Windows to the floor opening onto balconies help to create an effect of relationship with the outside, still

further increase the sense of spaciousness, and relieve the shut-in boxy feeling created in many apartment rooms.

For reasons of space economy living rooms have usually been located away from outside corners in order to be nearer to stair halls and public corridors. As this prevents living rooms from having the benefits of two exposures, consideration should be given to quality versus economy, and careful study may lead to methods of getting around this difficulty.

A foyer should be provided between the living room and the apartment entrance whenever possible. It is valuable as a buffer between the apartment and the outside and creates an added sense of privacy. In any case the entrance should never be at the same end as the windows, and diagonal circulation through the living room should be avoided (see Fig. 65A, B, C).

The former practice of providing separate dining rooms has almost entirely disappeared except in the highest priced units. Where it is planned that dining should be in the living room itself the room must be carefully planned to provide space for a table and chairs. Eating in the living room is open to many objections on the part of tenants and it is far better whenever possible to provide a separate recess for the purpose. This recess should be entirely open into the living room as it then serves the double purpose of adding to its appearance of spaciousness and relieves its box-like shape.

It is best to separate the kitchen entirely from this area with a partition and door, to keep kitchen odors and at times, untidy appearance, out of the living and dining space. In some buildings the dining space has been combined with the kitchen instead of with the living room, but this system lacks all of the advantages mentioned above and tenant preference is definitely in favor of combining the space with the living room. Such objections as have been made by tenants have generally been due to improper location and too small a sized recess. When, as in some plans, this recess serves also as a foyer, then, it is useless for dining, as such spaces are seldom large enough to serve both purposes with any degree of satisfaction or privacy (see Fig. 66D, E, F, G, H). In the case of Fig. 66H, where the space is too small to be of value for dining, and is larger than is needed for the foyer, it is better to incorporate the extra space in the kitchen than to waste it on a dining space that is a dining space in name only.

In luxury apartments where dining rooms are provided it is best to plan them so that they can be thrown open into the living room to provide additional space for entertaining large groups. Separation when desired can be effected with sliding or folding partitions and the usefulness of the space is thus greatly enhanced.

Bedrooms

The size and shape of bedrooms should be determined by space requirements for the furniture to be used, leaving sufficient space for circulation, dressing, and housekeeping. Bedrooms use as a minimum beds, bureaus, dressing tables, and chairs. Whenever possible beds should have space allowed for on both sides, especially in the case of occupancy by two people. In single bedrooms beds are sometimes placed along a wall, but they must then be moved in order to make them.

FPHA standards require 125 square feet for main bedrooms with a minimum of 90 square feet for single bedrooms and a minimum width of 8 feet 6 inches. FHA

standards call for 100 square feet for at least one bedroom in each unit, with a minimum of 70 square feet in any habitable room. Some building codes require a minimum width of 7 feet and a minimum area of 70 square feet. A good practical size for a bedroom to be occupied by two persons is 11 feet by 15 feet.

Closets for use by the occupants of a bedroom should never be placed outside of the room. In studying the furniture placement a position should be chosen for beds so that they will not face windows and it should not be necessary to walk around the beds to reach closets or other furniture. Closet doors should not be behind entrance doors, in such a position that the doors will clash if left open. If such a relationship of doors is necessary, sliding doors should be used on the closet (Fig. 67). For wide closets a pair of sliding doors is better and more economical to install than two hinged doors.

In luxury apartments separate dressing rooms are a good feature, and should be well fitted with suitable wardrobe equipment. Private baths may be arranged to open off dressing rooms instead of directly from the bedroom. Bedrooms in this type of unit should be planned with careful regard for many more pieces of furniture than are used in rooms of minimum requirements: extra size beds and headboards, dressing tables, chaise lounges, boudoir or slipper chairs, and varying sizes of chests, bureaus, desks, and combinations thereof.

Exterior Design

The general principles governing the design of the exteriors of apartment buildings do not differ from those governing the design of other buildings, and it is taken for granted here that the architect is already familiar with them and is skilled in their application. This discussion, therefore, will be confined to those elements having certain special phases particularly applicable to apartment buildings.

An attractive appearing building is a great asset to all concerned, the owner, the tenant, and the community in general. To the owner, because the attractive building will have fewer vacancies and hence will be a better business risk. To the tenant because of the psychological advantages of a well designed environment, and to the community at large because such buildings usually loom large in the neighborhood pattern and thus exert a considerable effect on the appearance and desirability of the entire community. That the mediocre appearance of most existing apartment buildings has been considered a detriment to neighborhood standards is evidenced by the frequent opposition by citizens associations to zoning changes which would permit the erection of apartment buildings in their neighborhoods. These objections are probably based also on objections to increases in population density and a possible fear of encroachment by differing income and social groups, but I believe that the question of appearance is also a large factor in such opposition.

The exterior of apartment buildings considered from the viewpoint of utility requires: (1) the use of light colored materials in order to reflect as much light as possible in courts and angles; (2) the elimination of superfluous ornament, because, due to the large bulk of such buildings, ornament must either be confined to a small area or be of a cheap material which can be repeated indefinitely at little cost. Even this little cost can generally be spent to better advantage, on added equipment or more generous use of space, where it will be of some real advantage to the tenants; (3) use of materials having a low maintenance cost.

From the standpoint of appearance these same points will almost invariably add to

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Fig. 68. Apartment building at 2700 Wisconsin Avenue, Washington, D. C. L. E. Breuninger & Sons, owners and builders; Joseph H. Abel, architect.

Fig. 69. Apartment building at 2100 Connecticut Avenue, Washington, D. C. Columbia Investment Co., owner; Charles Oshinskey, builder; Joseph H. Abel, architect.

Fig. 70. Apartment building at 2702 Wisconsin Avenue. Meyer Siegel, owner; Standard Construction Co., builder; Joseph H. Abel, architect.

the attractiveness of the building or group. Large buildings or groups of buildings built of a dark red brick have a generally depressing and monotonous effect, unless relieved by contrasting large areas of white, which are expensive to provide and to maintain. Buildings built, on the other hand, of light colored brick, stone, or concrete, have a much more pleasing effect, and greatly alleviate the feeling of overpowering mass which very large, dark colored buildings generate. For the general bulk of the building, effects are better obtained by careful attention to fenestration and variations in mass than by the addition of superfluous ornament (Figs. 68 to 75 inclusive).

In view of the large window areas required for adequate light and ventilation, it seems to me that any attempt to design apartment building exteriors with applied portions of historic styles is doomed to failure. On tall buildings, which try to apply such ornament, the result is usually a base heavily encrusted with ornament, surmounted by a large mass of wall pierced at monotonous intervals by inadequate windows, surmounted by a top story or two frosted like a wedding cake with a rash of cornice and belt courses. On 2 and 3 story buildings, which are frequently built in a sort of imitation Colonial style, the effect becomes monotonous in the extreme due to the necessary repetitions in building shape required for reasons of economy. The few variations used increase the sense of monotony rather than decrease it and cause a feeling of bewilderment in a large project, where at every turn in the road you seem to pass the same building that you have seen just around the corner.

The use of acres and acres of slate roofs, surmounted at infrequent intervals by out-of-scale cupolas, seems like so much sheer waste, especially at a time when housing is short and labor and materials are needed for the creation of more usable space. Even aside from this factor, such roofs fulfill no function on an apartment building that a flat roof cannot fulfill as well or better, and they cannot be justified

Leet Brothers

Fig. 71. Apartment building at 2141 Eye Street, Washington, D. C. Joseph H. Abel, architect; Lester Rosenberg, owner and builder.

Fig. 72. Apartment building at 2420 16th Street, Washington, D. C. Lester Rosenberg, owner and builder; Joseph H. Abel, architect.

Fig. 73. Three story walk-up buildings. Shapiro, Inc., owners and builders; Joseph H. Abel, architect. Red brick relieved with large window areas and white painted overhangs, spandrels, and entrance porches. Note variation attained by stepping buildings down with the sloping grade.

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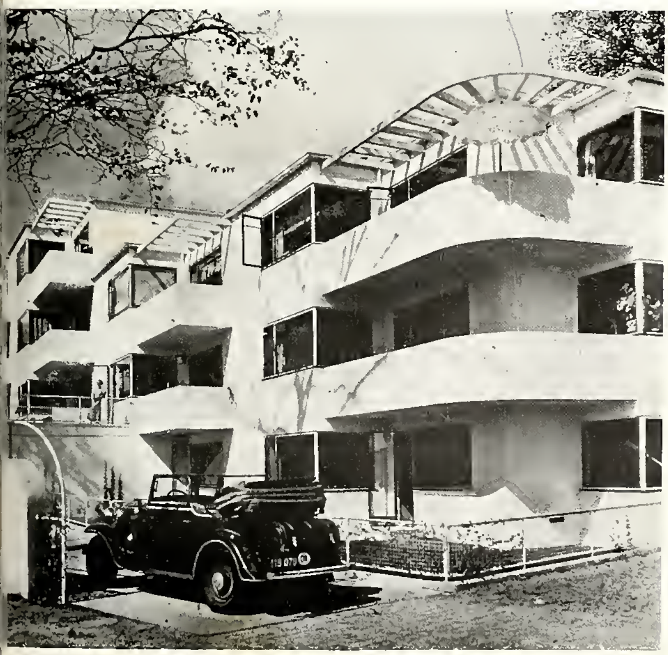
Fig. 74 (left). Bella-vista (south wing), Copenhagen, Denmark. Fig. 75 (right). Highpoint Flats, Highgate (London), England. Tecton, architects. A group of European buildings, illustrating a number of highly successful methods of treatment, by variations in mass, the use of balconies, and simple light colored exterior facing materials.



United States Housing Authority

Museum of Modern Art

Rodney McCay Morgan

Figs. 76–77. Entrance to apartment building at 2407 Fifteenth Street, Washington, D. C. Joseph H. Abel, architect. Transom bar is formed of standard show window sections of extruded aluminum. The exposed columns are covered with Alberene stone, 7/8″ thick. At right, entrance to apartment building at 2120 Sixteenth Street, Washington, D. C. Joseph H. Abel, architect. Stone around entrance and in wing wall is polished granite. The marquise is of concrete covered with stainless steel.

from a standpoint of appearance because their use seems to merely add to the monotonous appearance of the project. Buildings with flat roofs, varied in height to fit the ground contours, achieve a more interesting effect, and save money which can be used to better advantage elsewhere (Fig. 73). Flat roofs also offer an opportunity for the creation of sun decks for tenant use, and where these have been installed they have been given a great deal of use and have proved an attractive rental feature.

Very interesting effects can be obtained through the careful study of window sizes and placement and careful manipulation of the building mass. A good example is seen in the Rockefeller Apartments in New York City, Harrison and Fouilhoux, architects. No applied ornament has been used on these buildings, but a very pleasing effect has been obtained by the careful study of fenestration and mass. It should be noted that the windows are so placed as to have the maximum effect on the interiors as well as for their effect on the exterior appearance (Fig. 82A).

The main entrance of a building, being the focal point of the building design, at least from the point of view of a person approaching the building closely, is the appropriate place for a splurge in design if the building is of a type that can afford or has need for an attention-getting entrance. The use of richly colored luxurious masonry materials, such as polished granite, combined with areas of plate glass, in aluminum or stainless steel frames can give an air of pleasing luxury, if properly handled. A marquise projecting above the entrance gives an air of importance to the entrance as well as affording protection from the weather and shade for large glass areas. Masonry materials such as plain sawed or shot cut limestone, Alberene stone and Greenstone are capable of interesting and dignified treatment (Figs. 76, 78 to 81 inclusive).

Fig. 79. Entrance to apartment building at 2700 Wisconsin Avenue, Washington, D. C. Joseph H. Abel, architect. The curved wall at the left of the entrance is of limestone. The projecting course above the entrance is exposed concrete, as is the free standing column.

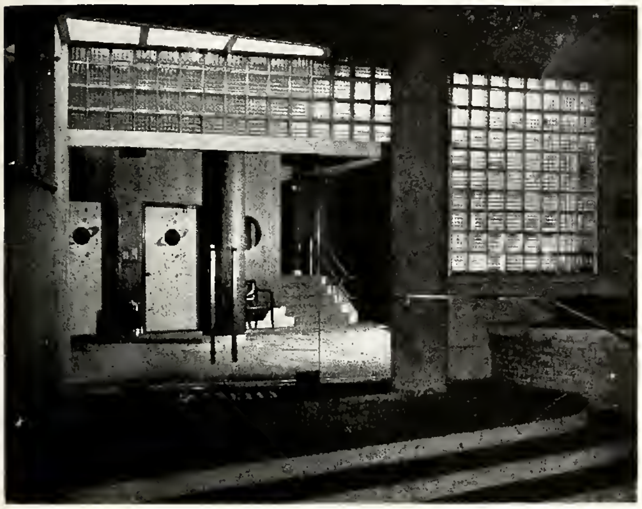


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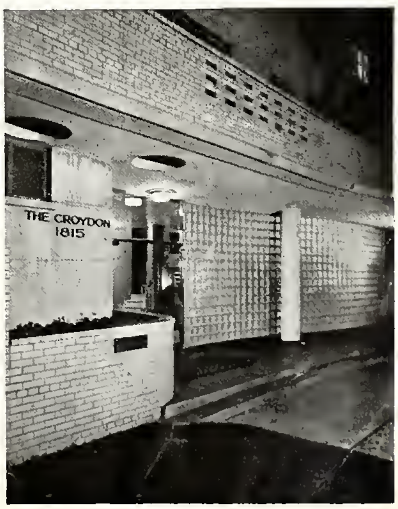
Fig. 78. Entrance to apartment building at 2141 Eye Street, Washington, D. C. Joseph H. Abel, architect. The round free-standing column is stuccoed. Window muntins are standard show window bars of extruded aluminum. Note recessed rubber mat in front of the tempered glass doors.

Fig. 80. Entrance to apartment building at 2720 Wisconsin Avenue, Washington, D. C. Joseph H. Abel, architect. Exposed columns covered with aluminum, projections of main building form shelter for recessed entrance.

Fig. 81 Entrance to apartment building at 2702 Wisconsin Avenue, Washington, D. C. Joseph H. Abel, architect. Stone around entrance and adjoining wing-wall is marble. Where marble is used care must be taken to select a type not affected to too great an extent by weather as most types are subject to great changes in color and finish on exposure.

Fig. 82. Entrance to the Croydon Apartments, Washington, D. C. Joseph H. Abel, architect. Curved glass black panel built of standard radial block. Exposed column is stuccoed as is soffit of exposed concrete marquise.



Such devices as setting back portions of the first floor front wall, leaving columns exposed, use of masonry planting boxes, interestingly textured stone walls, and terraces, or judicious use of areas of glass block help to give an interesting character to the entrance. Columns exposed as suggested above can be finished in a variety of ways. They may be rubbed smooth and painted, or stuccoed, or they may be covered with a thin shell of metal, either aluminum, bronze, or porcelain enamel giving a very good effect.

The effect of the building, as seen from a short distance, will depend, in addition to color and fenestration, to a large degree on interesting massing. A profusion of minor breaks added only for effect, frequently in a vain effort to make an 8 story building look like a skyscraper, succeeds only in creating an air of restlessness. Large, plain surfaces give an effect of dignity and repose and give added interest and importance to such breaks as are used. The skillful placing and arrangement of balconies and porches give opportunity for many interesting effects, which contribute to making a good facade as well as being in themselves useful from a standpoint of good living. Careful study of setbacks, penthouses, roof terraces, and other like features above the principal parapet line is important, for if carefully arranged they are capable of contributing much to the interest of the building silhouette.

Fig. 82A. Rockefeller Apartments, New York City, Harrison and Fouilhoux, architects.

CHAPTER 4: Planning Methods

Unit Plans

In addition to providing the necessary rooms and storage space, as discussed in Chapter 3, an analysis of their arrangement in terms of use, space quality, and circulation is of prime importance. A comparison of units to be used in a given project along the lines suggested in the following pages will give a sound basis for the selection of the units chosen, and will give the designer an assurance that he has selected the best possible use of space which the limitations of the site and the budget will permit. The accompanying sketches give an illustration of this method as applied to a number of typical units. A record kept over a period of years of the pertinent data used in such analyses will prove a very valuable reference for any architect engaged in apartment work. Comparison of this data on new work with such a record provides a continuing check on the efficiency of new unit plans as they are developed over a period of years, and as more data on peoples living habits in relation to the use of space become available. An architect should never permit himself to be content with the selection and repetition of a few standard units in all his apartment work, but should study the units to be used for each new building, in the light of all recent developments and added knowledge in the fields of new construction methods and materials, changes in building codes and zoning laws, and data as to use of space. There has been in the past too ready an acceptance of standard predigested units, and too little study of the sort suggested, which has resulted in stereotyped plans and the acceptance of many ideas without investigation as to their true worth.

Figure 83 shows a typical work sheet as used for the preliminary study of a one bedroom unit. This type of sketch can be used to quickly determine the possibilities of various room arrangements, and gives a sound basis for the selection of room arrangements for further detailed study. It was drawn at very small scale, 20 feet equals one inch. At this stage it is much easier to work at small scale and figure the dimensions than to draw at larger scale and check sizes by scaling the plan.

After exploring the various possibilities in this manner, a scheme must be chosen for further development and analysis. This choice is naturally a matter for the judgment of the designer and no hard and fast rules for selection can be laid down. In the example shown in Fig. 83, for instance, the choice would depend, firstly, on whether or not a balcony is desired and on the adequacy of the closets and dining space; and secondly, on considerations of the width and depth of the unit as affected by the shape of the building into which the unit is to be fitted.

After a preliminary exploration in this manner, several units should be chosen to receive further study. In order to make an intelligent choice it is necessary to start the preliminary studies of the shape of building plan to be used. The methods of studying this shape will be discussed later in this chapter under the heading "Building Planning." For the purpose of this discussion we will assume that this shape has been tentatively established and will proceed to the next step in the process of studying unit plans.

Unit Plan Analysis

The unit plans selected for further study should now be more carefully drawn at a larger scale. One-eighth inch equals one foot is a convenient size for this purpose. A tabulation of the items given in the following list will quickly make apparent the qualities of the unit plans considered for use.

ITEMS TO BE CHECKED IN THE ANALYSIS OF UNIT PLANS

1. *Gross floor area per unit*

2. *Gross floor area per room*

3. *Net floor area per unit*

4. *Percentage of net floor area of usable space compared to gross floor area*

5. *Perimeter of exterior wall per room*

6. *Circulation, with respect to privacy and room use*

7. *Circulation in relation to furniture arrangement*

8. *Location of windows and radiators in relation to furniture arrangement*

9. *Location of doors in relation to furniture arrangement*

10. *Location of exterior openings in relation to sunlight penetration*

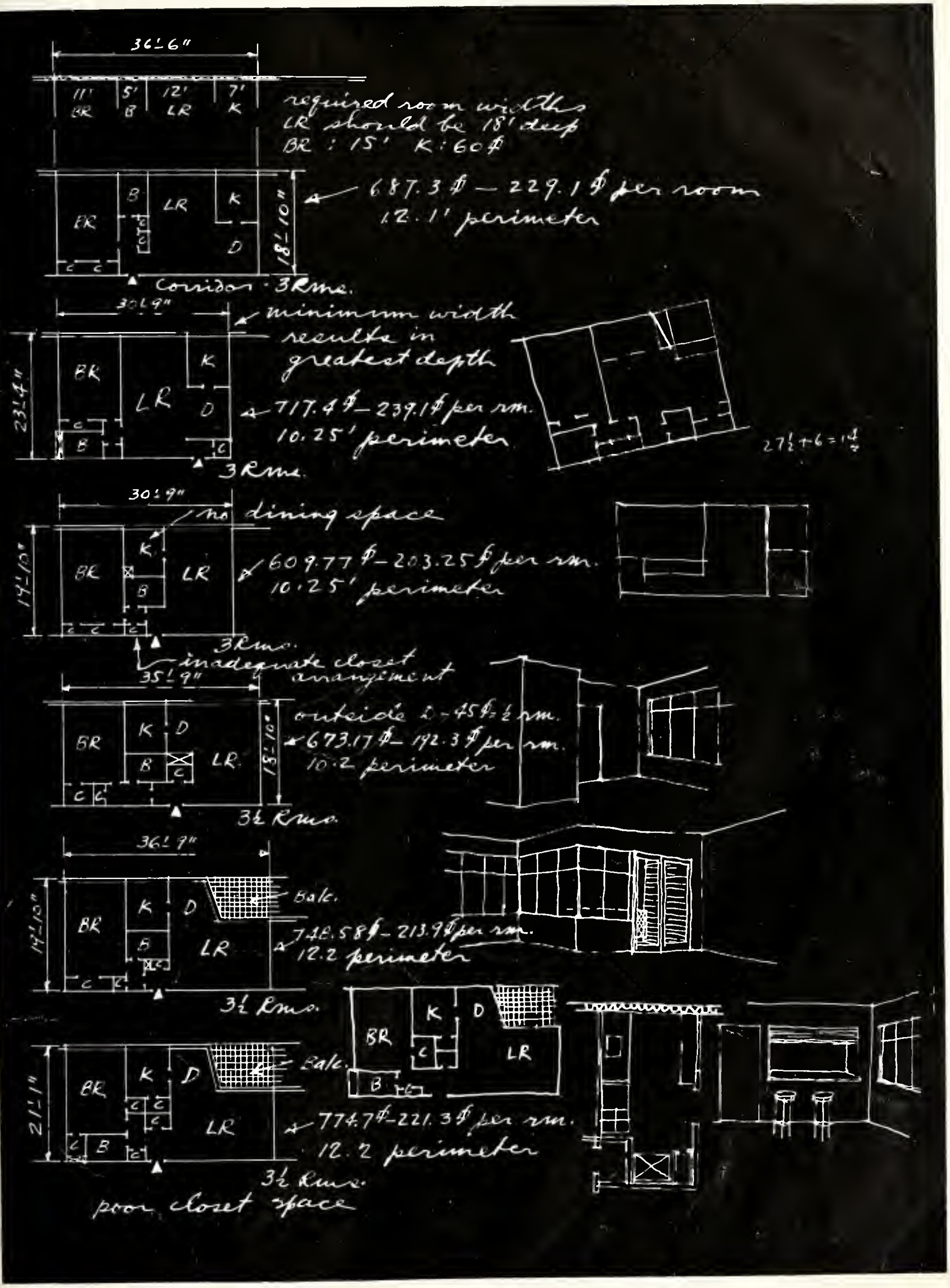
11. *Size and shape of rooms with respect to use and accommodation of furniture*

12. *Availability of through or corner ventilation (where mechanical ventilation is not used)*

13. *Provisions for closet and storage space*

14. *Structural considerations (possibilities of economical framing and column location)*

Fig 83.


36'-6"
11' BR
5' B
12' LR
7' K
required room widths
LR should be 18' deep
BR: 15' K: 60#
687.3# — 229.1# per room
12.1' perimeter
18'-10"
Corridor · 3Rms.
30'-9"
minimum width
results in
greatest depth
717.4#—239.1# per rm.
10.25' perimeter
3Rms.
30'-9"
no dining space
14'-10"
609.77#—203.25# per rm.
10.25' perimeter
3Rms.
inadequate closet
arrangement
35'-9"
15'-10"
outside 2-45#=½ rm.
673.17#— 192.3# per rm.
10.2 perimeter
3½ Rms.
36'-9"
14'-10"
Balc.
748.58#—213.9# per rm.
12.2 perimeter
3½ Rms.
21'-1"
Balc.
774.7#-221.3# per rm.
12.2 perimeter
3½ Rms.
poor closet space

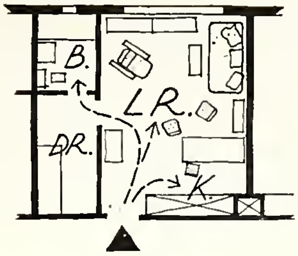


Fig. 84.
Unit A

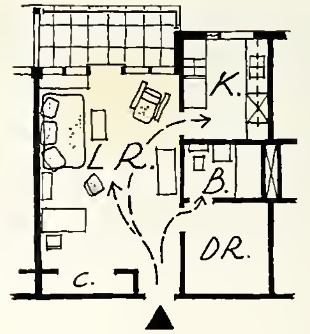


Fig. 86.
Unit C

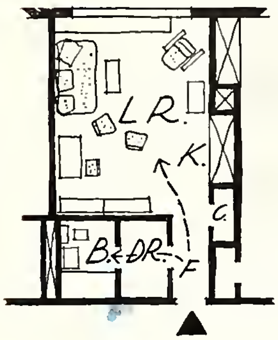


Fig. 85.
Unit B

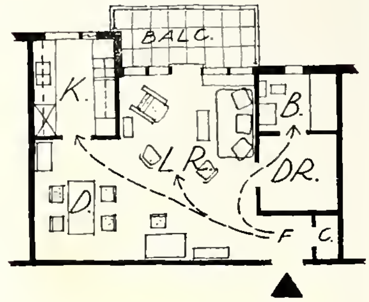


Fig. 87.
Unit D

Note: relation of units to each other and outlook with respect to the rest of the building and the site will be considered under building planning and site planning.

The following plans and tabulations illustrate the use of this method as applied to various types of units.

In the analysis of these units the following methods have been used in computing areas and determining room count:

For gross area of unit: from center to center of partitions laterally and from outer face of outside wall to center of interior partitions.

For net area: net floor area of all rooms, including foyers not in excess of 40 square feet. (If foyer exceeds 40 square feet count 40 square feet as usable space and balance as waste.) Include area of closets. Do not include areas of any partitions or walls, halls other than entrance foyers. or vent shafts.

Room Count:	Living Room	1
	Bedroom	1
	Kitchen	1
	Bath	0
	Balcony	0
	Inside Dinette	0
	Dinette with windows	½

In item 4, Percentage of net floor area of usable space compared to gross floor area, note that this figure is of significance only in comparing units of identical room size, as a change of room size will cause a change in this figure even with no change in plan layout.

In items 1, 2, and 3, note that these figures are not the same as those used in ana-

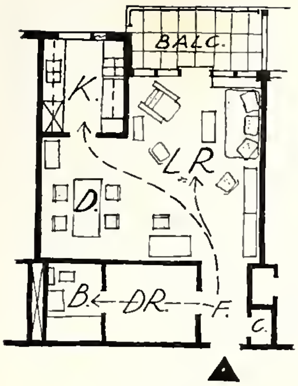


Fig. 88.
Unit E

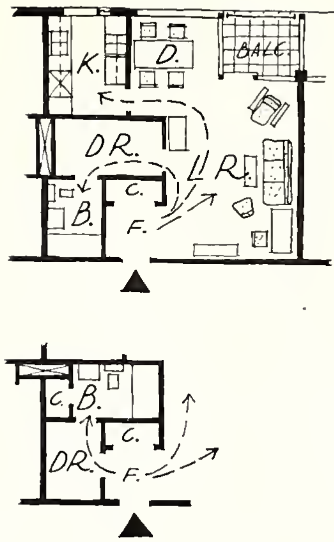


Fig. 89.
Unit F

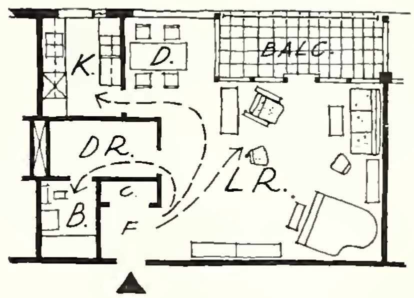


Fig. 90.
Unit G

lyzing plans of entire buildings, but apply to individual units only. The figures for unit and room areas for buildings are obtained by dividing the number of rooms or units into the gross floor area of the entire building.

Efficiency Units

Their principal characteristic is the use of one room for both living and sleeping space. Within this limitation they may have a considerable variation in size and appointments dependent on the expected rental range. Figure 84 shows a minimum type efficiency unit and Figs. 85 and 86 variations and development with increased size.

ANALYSIS OF UNITS SHOWN IN FIGURES 84, 85, 86

	Unit A	Unit B	Unit C
1.	361 S.F.	426.5 S.F.	534 S.F.
2.	361 S.F.	426.5 S.F.	267.0 S.F.
3.	322 S.F.	352 S.F.	470.75 S.F.
4.	89.7%	82.5%	88.1%
5.	19 Ft.	16 Ft.	12 Ft.
6.	OK	OK	OK
7.	OK	OK	OK
8.	OK	OK	OK
9.	OK*	OK*	OK
10.	OK	OK	OK
11.	OK	OK	OK
12.	No†	No†	No†
13.	Minimum	Minimum	OK
14.	OK	OK	OK

* Location of dressing room doors is not suitable for use of jamb hung closet type bed. Roll-away type may be used if desired.
† This type of unit needs mechanical ventilation.
Note: Strip kitchen units must be provided with mechanical ventilation. Living rooms should contain not less than 220 square feet and should not be less than 12 feet wide. Dressing rooms should be fitted with built-in wardrobe equipment to help take the place of bedroom furniture.

ANALYSIS OF UNITS SHOWN IN FIGURES 87, 88, 89, 90

	Unit D	Unit E	Unit F	Unit G
1.	579 S.F.	573 S.F.	529 S.F.	724.5 S.F.
2.	289.5 S.F.	286.5 S.F.	211.6 S.F.	289.8 S.F.
3.	443.5 S.F.	526 S.F.	468 S.F.	651.5 S.F.
4.	86.5%	91.7%	88.4%	89.9%
5.	16.5 Ft.	11.5 Ft.	11.2 Ft.	15.2 Ft.
6.	OK	OK	OK‡	OK‡
7.	OK	OK	OK	OK
8.	OK	OK	OK	OK
9.	OK	OK*	OK*	OK*
10.	OK	OK	OK	OK
11.	OK	OK	OK	OK§
12.	No†	No†	No†	No†
13.	OK	OK	OK	OK
14.	OK	OK	OK	OK

* Location of dressing room doors is not suitable for use of jamb hung closet type bed. Roll-away type may be used if desired.
† This type unit needs mechanical ventilation.
‡ Rearrangement of bath and dressing room as shown in Fig. 89 improves circulation and living room wall space.
§ Note that units shown in Figs. 89, 90 are the same except for increase in size of living room. Note change in item 4. Note advantages in layouts gained by use of inside baths.

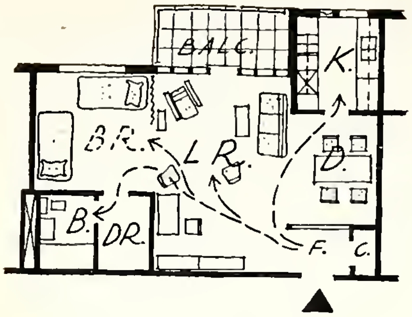


Fig. 91.
Unit H

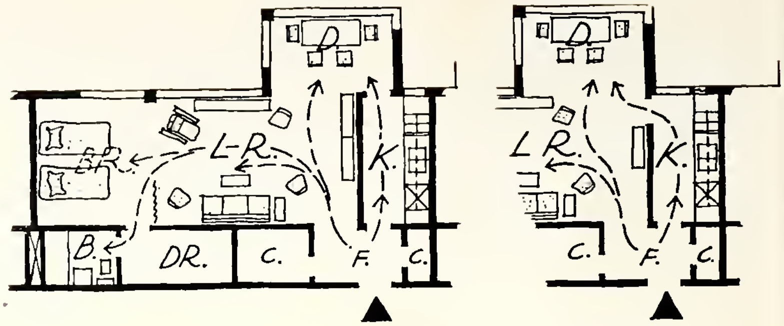


Fig. 92.
Unit I

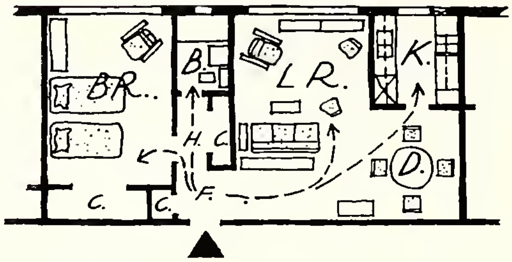


Fig. 93.
Unit J

Closet type beds may be made optional equipment, as it has been found by experience that many tenants prefer to use a studio couch and have the additional closet space gained by elimination of the closet bed. Partitions between adjoining living rooms should be sound-proofed. Mechanically ventilated baths as shown in Figs. 85 and 86 are usually permitted by law only in buildings of 5 stories or more in height. Inside baths prove a great economy in construction cost as inside space is cheaper to provide than outside perimeter. The mechanical ventilation provides better ventilation than that obtainable with windows, gives increased privacy, and added flexibility of unit arrangement. Separate outside kitchens as in Fig. 86 should have individual exhaust fans direct to the outside to keep living rooms free of cooking odors and increase comfort while working in the kitchen.

The units shown in Figs. 87, 88, 89, 90 have been increased in size to include a separate dining space. The omission of a dividing partition between living and dining space gives an added air of spaciousness and increased flexibility of use of space.

When the efficiency unit grows much beyond the sizes shown above it graduates into the high rental brackets and its name is then usually changed to a "studio" apartment, which gives it an appeal to certain types of tenant. This type of unit generally occupies as much space as a one bedroom apartment, but due to the openness of its plan has an air of greater spaciousness. A few such units in high rental buildings will generally prove desirable and profitable, as such units frequently command a rental premium.

Housekeeping Units

The general characteristic common to all of these units is the provision of complete living facilities for family groups with separate spaces for sleeping, living, and all the other functions of family life.

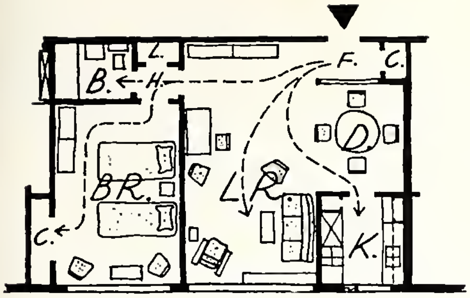


Fig. 94.
Unit K

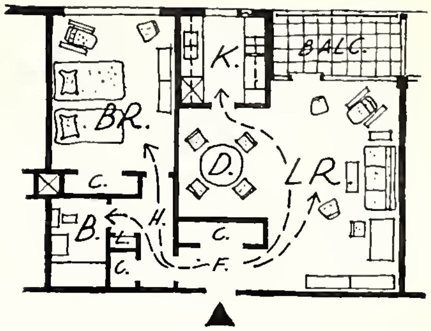


Fig. 95.
Unit L

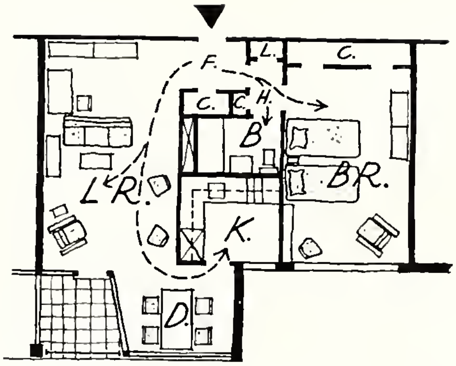


Fig. 96.
Unit M

ANALYSIS OF UNITS SHOWN IN FIGURES 91, 92

	Unit H	Unit I
1.	713 S.F.	726.5 S.F.
2.	356.5 S.F.	242.1 S.F.
3.	628 S.F.	605 S.F.
4.	88%	83.2%
5.	14.4 Ft.	21.1 Ft.
6.	OK	OK‡
7.	OK	OK
8.	OK	OK
9.	OK	OK
10.	OK*	OK
11.	OK	OK
12.	No†	No†
13.	Minimum	OK
14.	OK	OK

* Glass screen between foyer and dining space will help light foyer and increase its apparent size.
† This type unit needs mechanical ventilation.
‡ Note effect of shift in location of dining space as shown in Fig. 92.

ANALYSIS OF UNITS SHOWN IN FIGURES 93, 94, 95, 96

	Unit J	Unit K	Unit L	Unit M
1.	731.2 S.F.	745.8 S.F.	828.75 S.F.	860.7 S.F.
2.	243.7 S.F.	248.6 S.F	276.25 S.F.	245.9 S.F.
3.	604.5 S.F.	649.5 S.F.	699 S.F.	714 S.F.
4.	82.6%	85%	84.3%	82.9%
5.	12.5 Ft.	11 Ft.	12.7 Ft.	11.4 Ft.
6.	OK	OK‡	OK	OK
7.	OK	OK	OK	OK
8.	OK	OK	OK	OK
9.	OK	OK	OK	OK
10.	OK	OK†	OK	OK
11.	OK	OK	OK	OK
12.	No*	No*	No*	No*
13.	Minimum	Minimum	Minimum	Minimum
14.	OK	OK	OK	OK

* This type unit needs mechanical ventilation.
† Glass screen between foyer and dining space will help light foyer and increase its apparent size.
‡ Crossing living room for access to bath and bedroom is not objectionable in unit designed for occupancy by two persons.

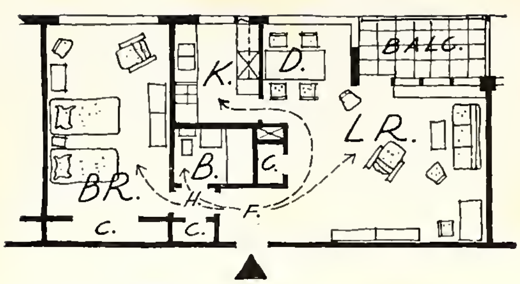


Fig. 97. *Unit N*

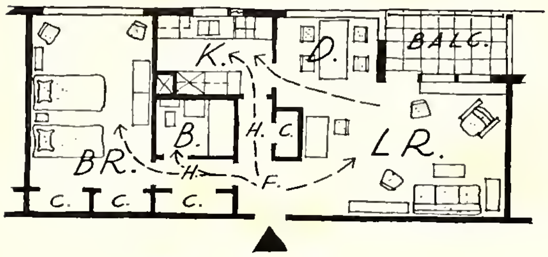


Fig. 98. *Unit O*

Unit P Fig. 99.

ANALYSIS OF UNITS SHOWN IN FIGURES 97, 98, 99

	Unit N	Unit O	Unit P
1.	840 S.F.	817 S.F.	1063 S.F.
2.	240 S.F.	233.4 S.F.	354.3 S.F.
3.	687 S.F.	668.6 S.F.	877 S.F.
4.	81.7%	81.8%	82.5%
5.	12.8 Ft.	14 Ft.	12.3 Ft.
6.	OK*	OK*	OK
7.	OK	OK	OK
8.	OK	OK	OK
9.	OK	OK	OK
10.	OK	OK	OK
11.	OK	OK	OK
12.	No†	No†	No†
13.	Minimum	Minimum	OK
14.	OK	OK	OK

* Direct circulation from kitchen to foyer as in Fig. 98 is improvement over circulation through living room as in Fig. 97 but in this case requires increased perimeter which means increased building cost.
† This type unit needs mechanical ventilation.
Unit shown in Fig. 99 is designed for inside corner; inside space left would be used for stairs, elevators, etc.

ANALYSIS OF UNITS SHOWN IN FIGURES 100–104 INCLUSIVE

	Unit Q	Units R & S	Unit T	Unit U
1.	1035 S.F.	1160 S.F.	1012 S.F.	1029 S.F.
2.	258.7 S.F.	257.7 S.F.	253 S.F.	257.2 S.F.
3.	887.5 S.F.	916.75 S.F.	837 S.F.	917 S.F.
4.	86%	79%	82.7%	89%
5.	11.2 Ft.	12.4 Ft.	16.5 Ft.	19.8 Ft.
6.	OK	OK†	OK	OK
7.	OK	OK	OK	OK
8.	OK	OK	OK	OK
9.	OK	OK	OK	OK
10.	OK	OK	OK‡	OK‡
11.	OK	OK	OK	OK
12.	No*	No*	Corner§	Corner§
13.	Minimum	Minimum	Minimum	Minimum
14.	OK	OK	OK	OK

* This type unit needs mechanical ventilation.
† Units R and S are the same except for hall from kitchen to foyer, improving circulation and obviating need for carrying packages, etc., through the living room.
‡ Glass screen between foyer and dining space will help light foyer and increase its apparent size.
§ Units T and U have corner ventilation, but should also have mechanical ventilation, because under ordinary conditions air would not circulate through living room and small bedroom.

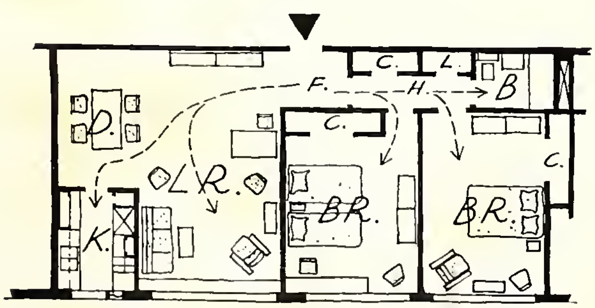


Fig. 100.
Unit Q

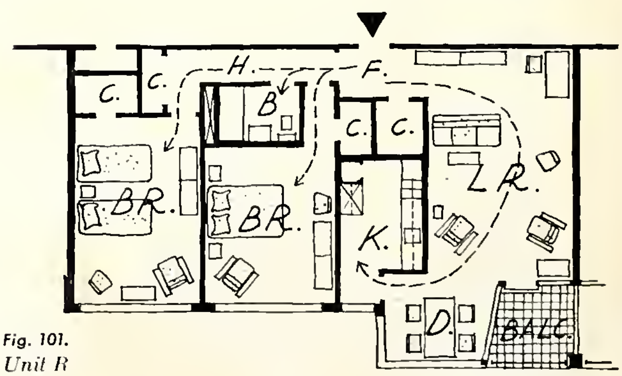


Fig. 101.
Unit R

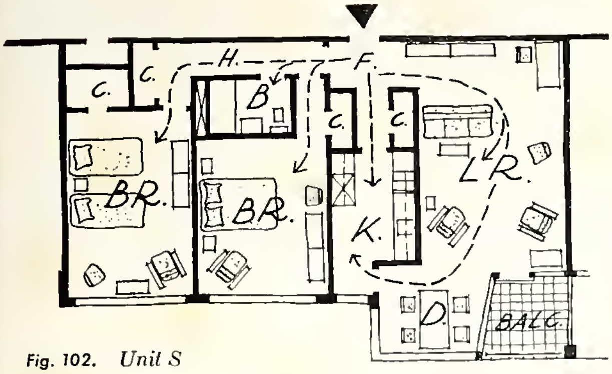


Fig. 102. *Unit S*

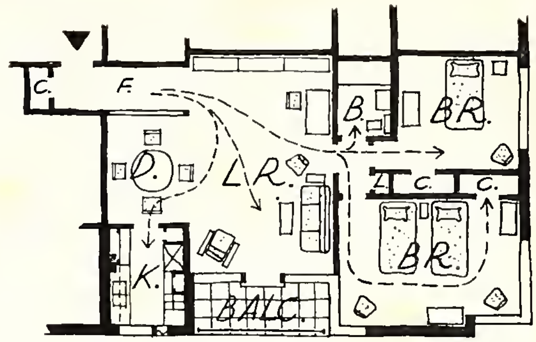


Fig. 104. *Unit U*

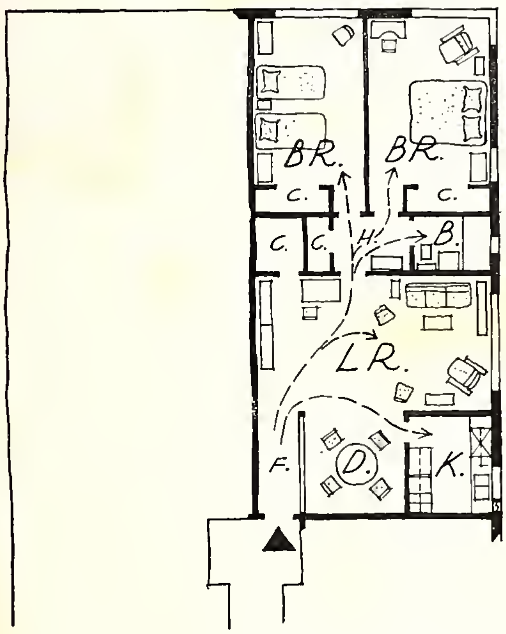


Fig. 103.
Unit T

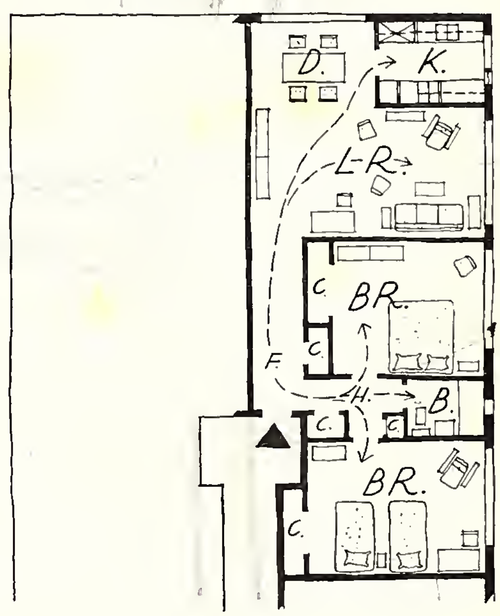


Fig. 105.
Unit V

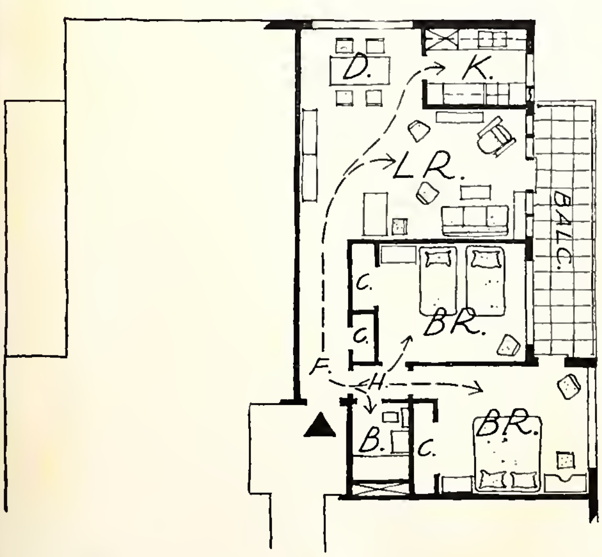


Fig. 106.
Unit W

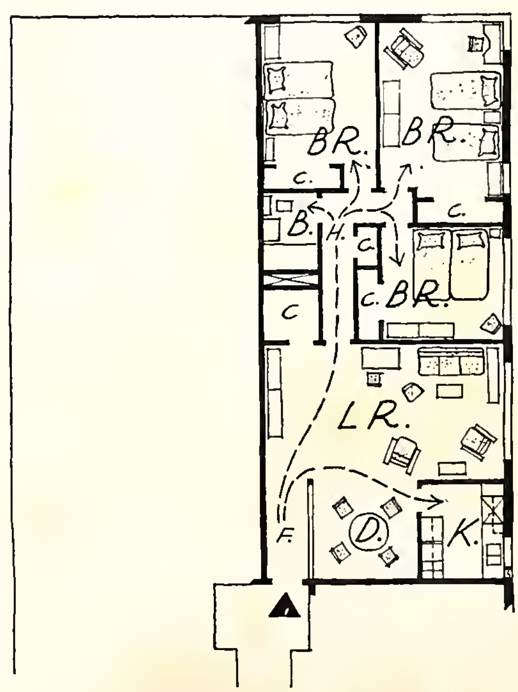


Fig. 107.
Unit X

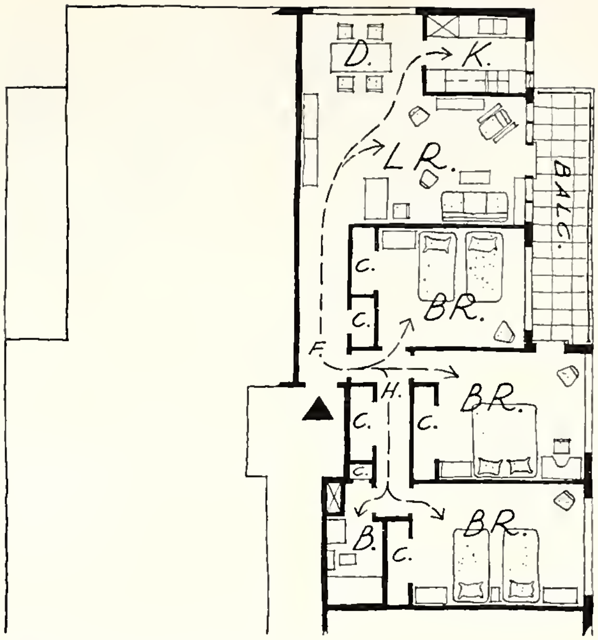


Fig. 108.
Unit Y

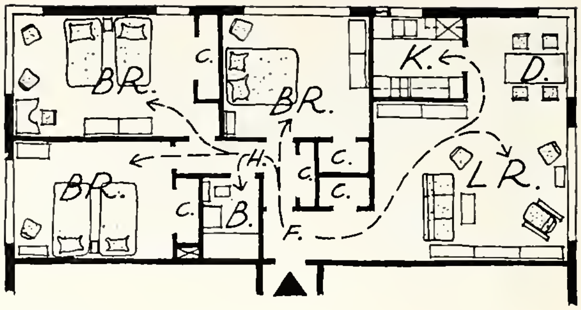


Fig. 109.
Unit Z

ANALYSIS OF UNITS SHOWN IN FIGURES 105–109 INCLUSIVE

	Unit V	Unit W	Unit X	Unit Y	Unit Z
1.	1086.5 S.F.	1067.5 S.F.	1173 S.F.	1308 S.F.	1173 S.F.
2.	241.4 S.F.	237.2 S.F.	234.6 S.F.	237.8 S.F.	213.2 S.F.
3.	886.5 S.F.	985 S.F.	957 S.F.	1134 S.F.	969 S.F.
4.	81.5%	82.2%	81.5%	86.6%	82.6%
5.	16.2 Ft.	15.3 Ft.	14.8 Ft.	14.7 Ft.	17.6 Ft.
6.	OK	OK	OK	OK	OK
7.	OK	OK	OK	OK	OK
8.	OK	OK	OK	OK	OK
9.	OK	OK	OK	OK	OK
10.	OK	OK	OK	OK	OK
11.	OK	OK	OK	OK	OK
12.	Corner*	Corner*	Corner*	Corner*	Through*
13.	Minimum	Minimum	Minimum	Minimum	Minimum
14.	OK	OK	OK	OK	OK

* These units should have mechanical ventilation in addition to their corner or through ventilation because under ordinary conditions air would not circulate through most of the rooms in sufficient amounts.

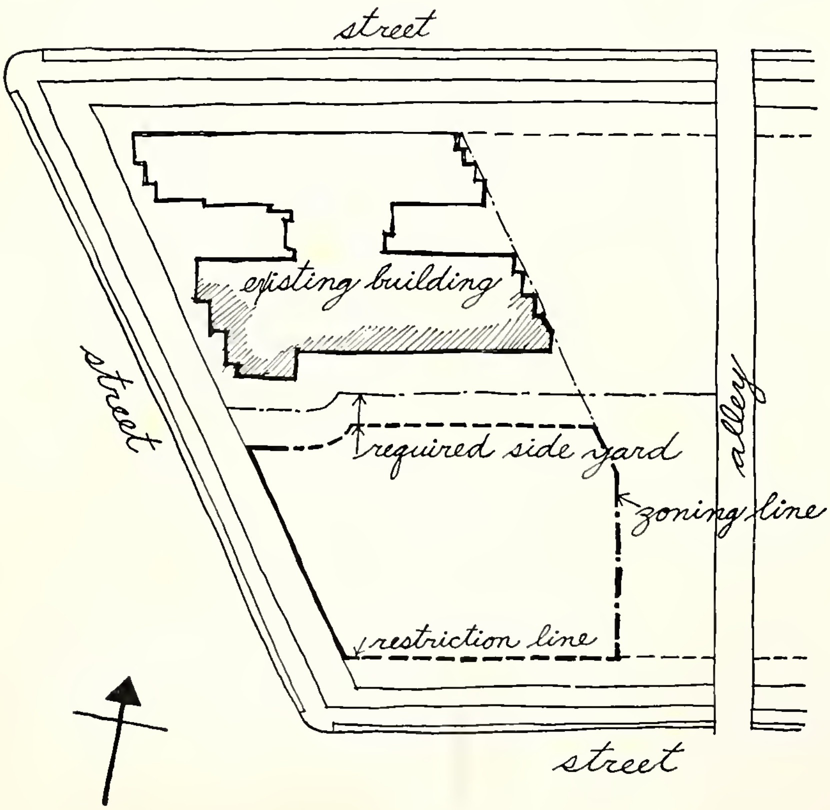


Fig. 110.

Building Planning

The two types of building plan as determined by the shape and size of the lot, as discussed in Chapter 3, will be considered separately. The first to be discussed will be the constricted type, in which the various possible building shapes are determined by the shape and area of the site, and are influenced to a large degree by neighboring buildings and other conditions beyond the control of the designer.

The process, in general, consists of first determining, by means of a series of rough sketches, the best possible shape for the building in conformity with the restrictions imposed by the site, and of then cutting this shape up into apartment units. As an illustration of the method of planning a constricted type building, I propose to use as an example a building planned by Berla & Abel, architects, following through step by step the entire design process to the point at which the sketches are ready for the working drawing stage.

Constricted Type Plan Development: Step 1

Preliminary conference with the owner. The following information was obtained: The building was to be located on a site already in possession of the owner on a prominent street. The neighborhood contained many existing apartment buildings of good rental type, ranging in age from about 5 to 10 years old. The fact that no new buildings had been built during the past 5 years was due to the war and did not indicate any lessening demand in this location for new buildings. The general character of units in the neighboring buildings and the established range of rentals indicated that the rent for the proposed new building should be about $30 per room per month. The land over the entire site had been filled in to a depth of 30 to 40 feet and the building would require pile foundations. The owner of the building was also the owner of other buildings in the neighborhood and so had a good knowledge of the type of units that would be in demand. He requested that about one-half of the apartments should consist of one bedroom units, and that the balance be divided about 50-50 between two bedroom and efficiency units. Two bedroom apartments were to be provided with two baths each and efficiency units should be of a rather spacious type provided with good sized kitchens and separate dining spaces.

Step 2

Investigation of site. A visit to the site and a check on surveys, deeds, and zoning requirements showed the lot to be as indicated in Fig. 110. The building to the north was 8 stories high and its location had to be considered in relation to the proposed new building. The front portion of the lot was zoned for apartment use and permitted a building 8 stories in height. The land to the east of the line marked "zoning line" on the sketch was restricted to single family houses and no portion of the apartment building could extend over this line. This part of the lot could, however, be included as a part of the lot area in figuring the allowable lot occupancy and could serve as the required rear yard for the building. In addition, it could be used for parking cars, being conveniently located adjacent to an alley. It thus formed a valuable addition to the site even though it could not be built upon. The restriction line to the south was a line established by the surveyor's office, the main portion of the building could not pass this line, but it was permitted to extend bay windows and balconies over this line a distance of four feet, with a width not to exceed one-half of the width of the building. The set back from the north line was drawn on the sketch as required by the zoning ordinance, thus these three lines and the front lot line established the space within which the building had to be planned to fit.

Step 3

Determination of building shape. In order to determine the required thickness of building it was necessary at this point to decide on the type of apartment unit to

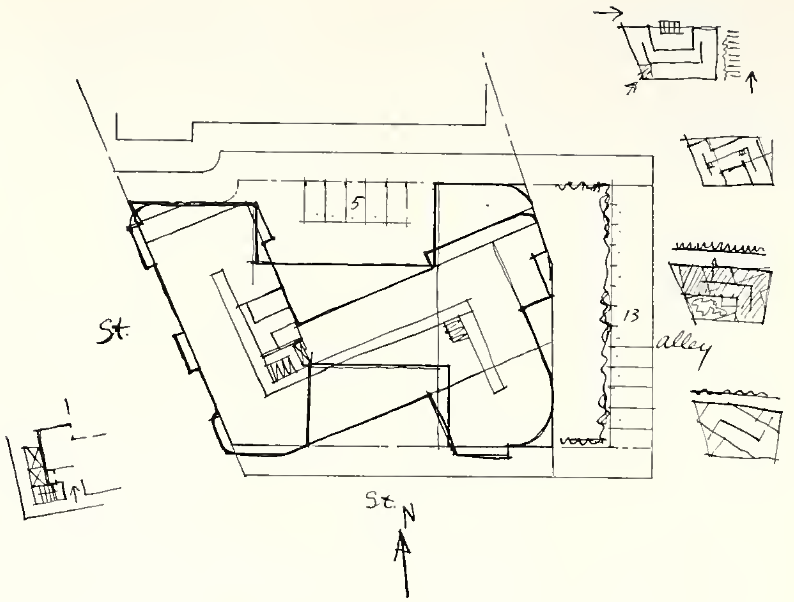


Fig. 111.

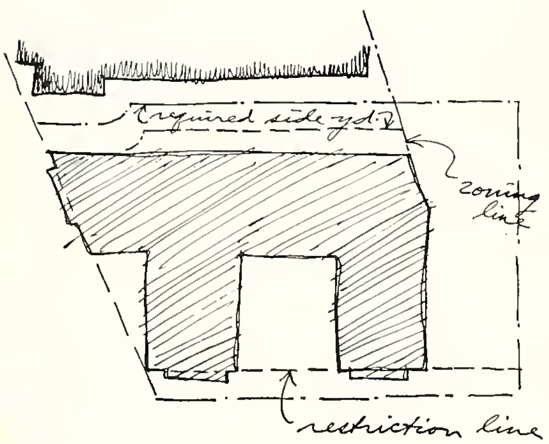


Fig. 112.

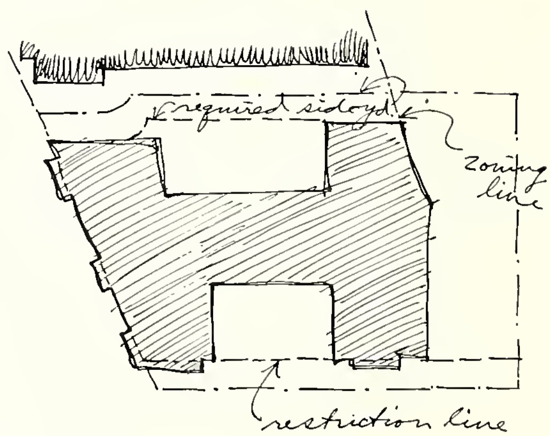


Fig. 114.

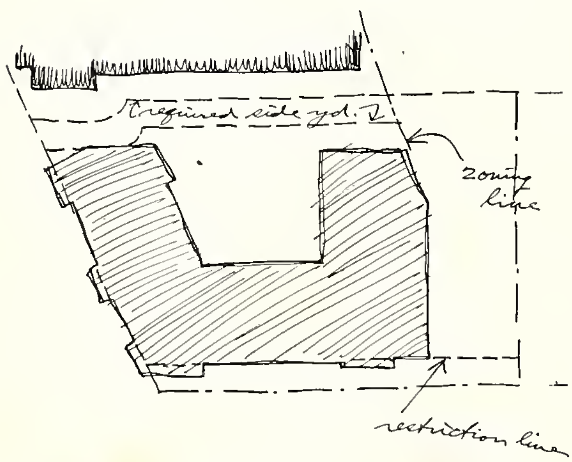


Fig. 113.

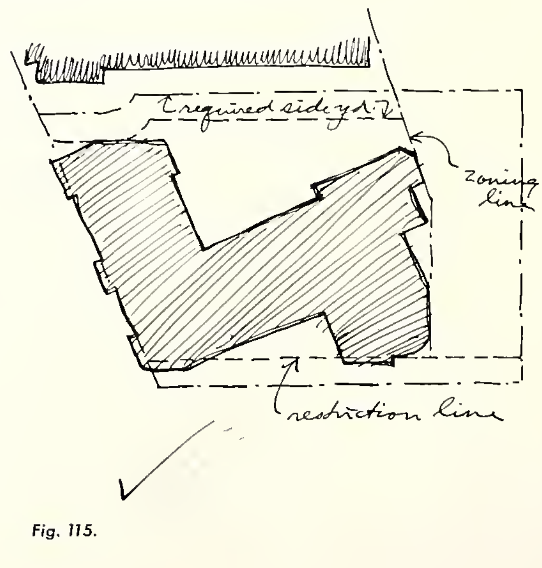


Fig. 115.

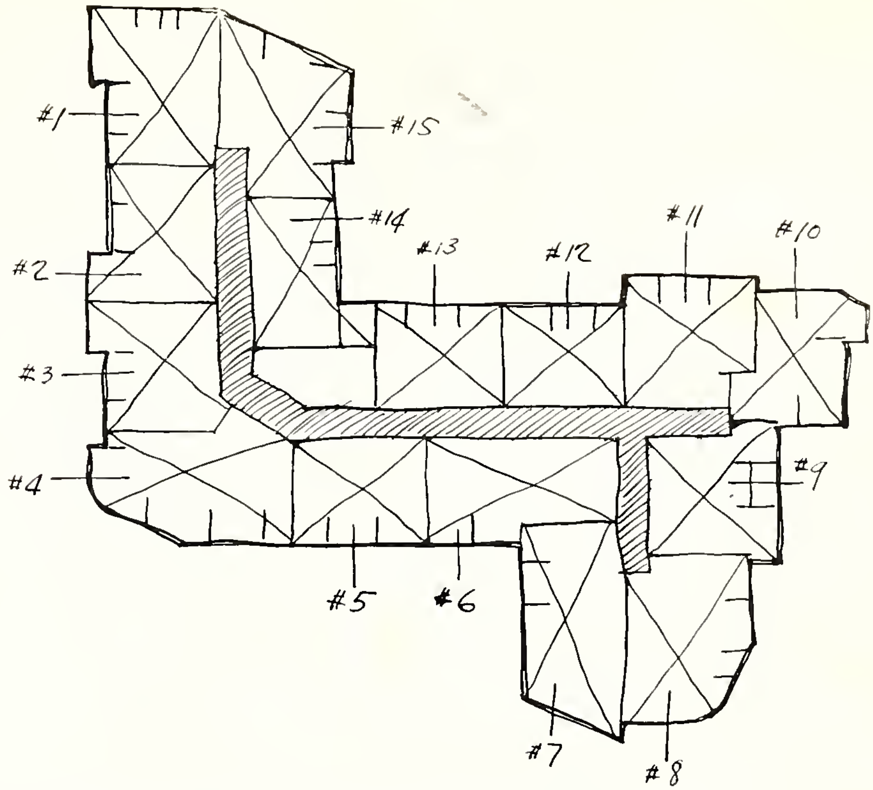


Fig. 116.

be used, and preliminary sketches were made of unit types, as discussed earlier in this chapter. After reaching a decision on the type to be used the required thickness was easily determined by adding the depth of two units, plus the required corridor width, plus wall and partition thickness. This thickness was found to be approximately 50 feet. The allowable lot coverage under the zoning law was computed and found to be about 20,000 square feet. A comparison of this area with the area of the part of the lot that could be built on showed that the building would occupy a very high percentage of this portion of the lot. With these preliminary conditions in mind several rough sketches were made of possible building shapes fulfilling these conditions, as shown in Figs. 111 to 115 inclusive. Figure 111 shows several quick sketches made one over the other as a preliminary guide to possible shapes to be considered. The doodles around the edges of the drawing represent various shapes that came to mind. These sketches gave a quick survey of the possibilities inherent in the lot and served as a rough guide for the sketches which followed.

Figure 112 had a large amount of area but was rejected because the narrowness of the court on the street side and the long straight wall paralleling the existing building to the north would result in too many apartments having a poor outlook. Figure 113 was rejected because the court facing the existing building would result in a large number of units having no outlook other than into the court or the existing building. Figure 114 was discarded for similar reasons and also due to the fact that the division into four wings would result in an excessive amount of dead interior space. Figure 115 was selected as a basis for further study as it was felt that it gave the most open effect possible under the existing conditions. Placing the building at an angle to the existing building gave the widest possible space between the new building and the existing one and possibility for a view past the building to a maximum number of apartments.

A preliminary check of the building area indicated a lot coverage of about 18,000

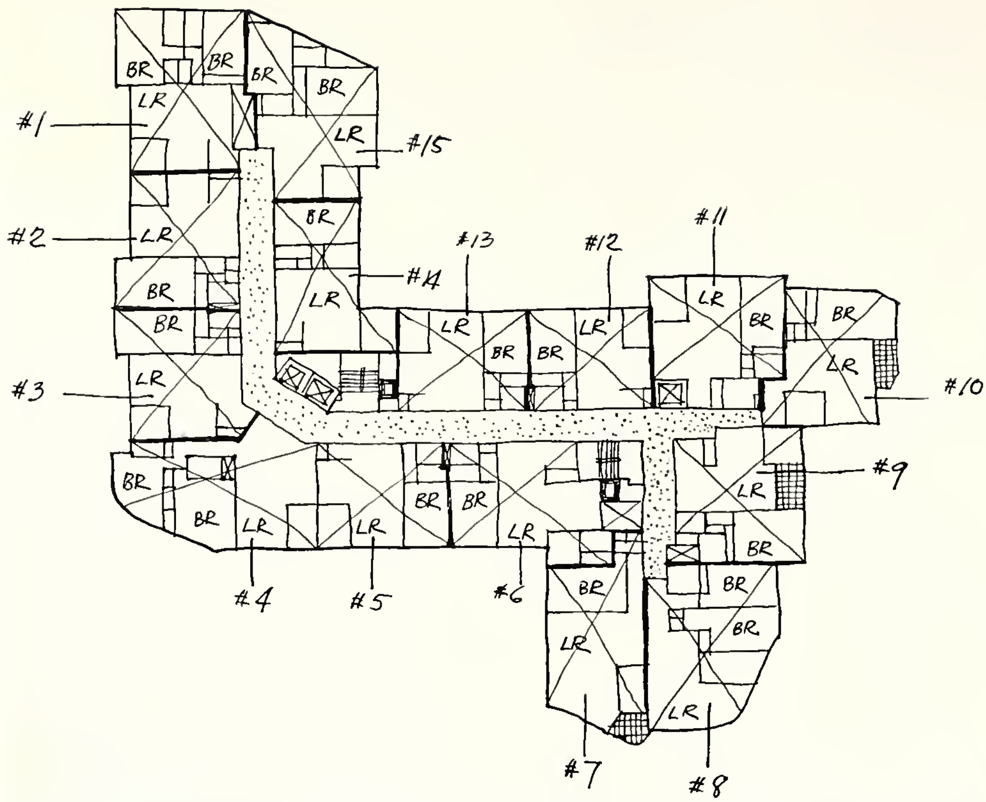


Fig. 117

square feet, well within the legal limit, and about as close to the maximum allowed as was consistent with the existing site conditions. Space for parking could be provided along the alley to the east and in a garage under the building.

These sketches were drawn at a scale of 40 feet equals one inch. The great influence played by the existing zoning regulations in determining this preliminary outline should be noted. It is of the utmost importance that the architect thoroughly familiarize himself with the regulations in effect before attempting any preliminary sketches, and unless he is experienced in the application of the zoning ordinance in question, it is a wise precaution to submit the preliminary sketch to the officials in charge for an opinion as to its conformity. Zoning ordinances are frequently obscurely worded and may be subject to a wide range of interpretation so that it is not always possible to be sure that all requirements have been met merely by a study of the law as it is written. An error in interpretation if not caught at this point may require expensive redrawing of plans and serious delay in the start of construction. So play it safe.

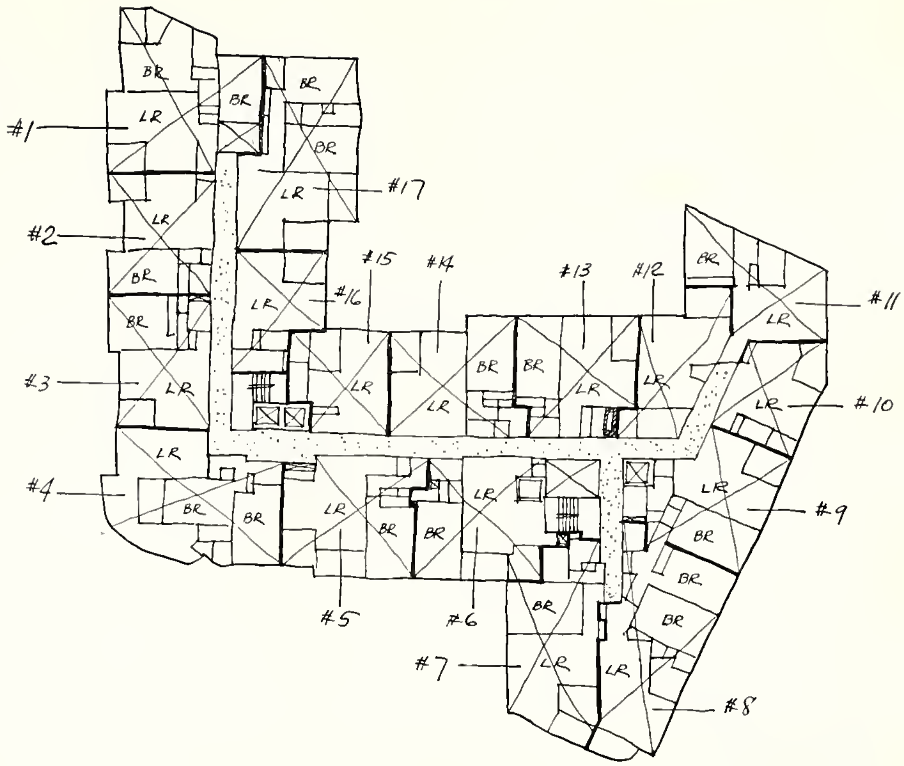
Step 4

The building outline decided upon in Fig. 115 was then drawn at a scale of 20 feet equals one inch and another check of the area gave a building size of about 17,500 square feet. It was decided to use room sizes about as follows:

For living rooms.......... 12 × 22
For bedrooms............ 11 × 17
Kitchens................ 60 square feet (the minimum size permitted by the building code)
Baths.................... 5 × 7-6

A comparison of the building area with comparable buildings indicated the prob-

Fig. 118.



able number of rooms obtainable per floor as 50, or a total of 400 rooms on eight floors. It was decided to use two passenger elevators and one service elevator and to provide mechanical ventilation for the units. Some consideration was given to providing complete air conditioning for the building, but after considering preliminary estimates furnished by our mechanical engineering consultants, this idea was rejected by the owner as being too expensive.

The plan outline was then subdivided by drawing a corridor down the center, dividing the perimeter off into room sized spaces and indicating roughly the outlines of apartment units. This rough sketch showed 15 units with about 49 rooms (Fig. 116).

Step 5

The next step was to divide this space further into actual apartment layouts and locate elevators, stairs, vent shafts, etc., as shown in Fig. 117. This plan did not provide for any efficiency units as required and another sketch was made to divide the rooms on this basis as shown in Fig. 118. This layout gave 17 apartments per floor with 51 rooms, divided as required into two bedrooms, one bedroom, and efficiency units.

It is important to remember when working at very small scale that it is very easy to be over optimistic about scaled sizes. This always leads to trouble when the plan is laid out at large scale, as a very small amount of variation in the small scale layout may amount to a great deal in the large scale layout, resulting in the necessity for an entire restudy of the plan in order to get it to work. A good method to use in order to avoid this difficulty is to scale only large units in the plan, by calculating the size of entire apartment units and scaling off unit sizes rather than individual room sizes. Figure 119 indicates a typical unit width as calculated. These widths are then indicated on the small scale sketch and combined as shown.

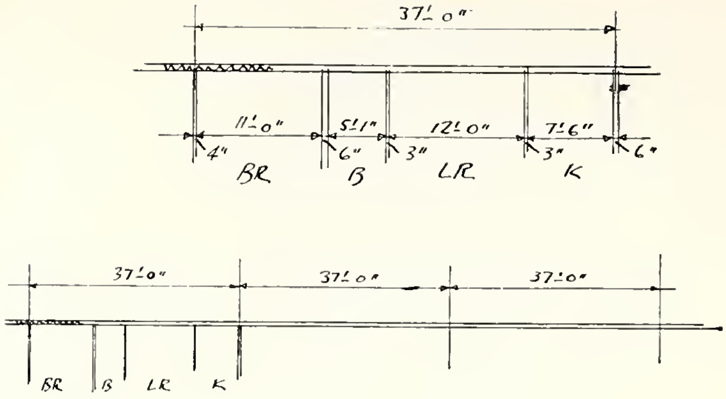


Fig. 119.

By adding these sizes, and comparing the totals obtained with the over-all building length available, it is possible to keep a sketch at even a very small scale accurate enough for the scheme to work when drawn at large scale. Working at very small scale in the preliminary stages will be found to be a tremendous time saver and an aid to good design because it is possible in a comparatively short time to study several different schemes, which might require an immense amount of time if laboriously worked out at large scale.

Step 6 Preliminary study of lobby and service areas. These areas were roughly blocked out and their relations to streets and alleys studied as shown in Fig. 120. It was decided to place the lobby at the basement level as the slope of the adjoining streets left this portion of the basement well above grade at the corner of the two streets. Parking and garage space was laid out, and spaces for ventilating fans and boiler room decided on in consultation with the mechanical engineers. Service entries, laundering, and janitor's quarters used all the remaining space and it was decided to use space in the sub-basement for storage.

Step 7 The plan shown in Fig. 118 was then blocked out at a scale of ⅛" to one foot, the units studied in detail, and the location of beams and columns laid out in conjunction with our structural engineer.

Step 8 Study of Exterior. The building was then laid out in perspective to study the general effect, and perspective sketches were also made of entrance details and the interior of the lobby as shown in Figs. 121 to 124 inclusive.

Step 9 The typical floor sketch was then completed as shown in Fig. 125 and the sketches were then ready for the working drawing stage. It is frequently helpful to make rough studies of interiors as shown in Fig. 126 to assist in visualizing portions of

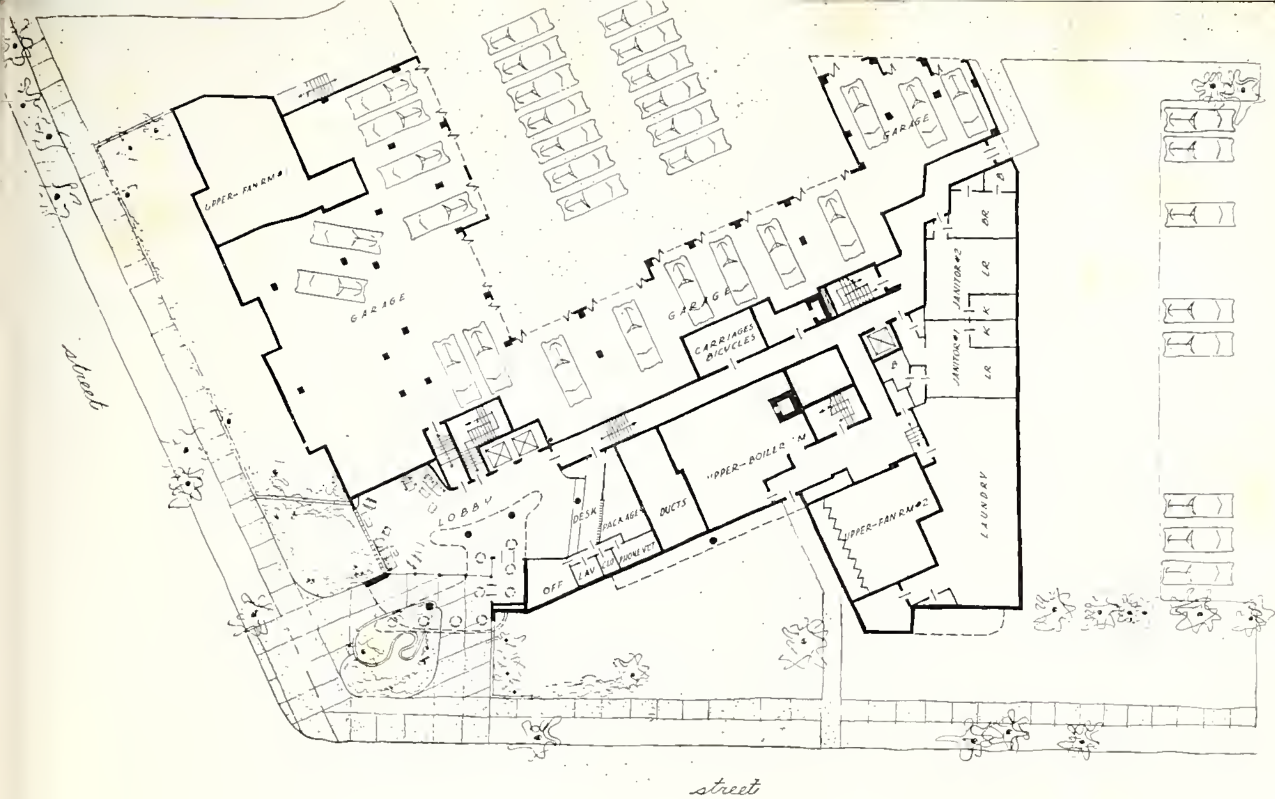


Fig. 120.

the interior of units. It is important to note that the sketches were kept in very rough form until ready for the final stages, this facilitates study and changes as the plan develops and saves a great deal of time which would otherwise be wasted in working out details of some particular unit which might later have to be changed. The method of blocking out the plan in whole units is a great time saver in the beginning stages, as it insures that the plan will come out even and not leave a small piece of space dangling at one end of the building which would require a great deal of juggling to incorporate into the rest of the plan as would probably happen if each unit had been worked out in detail around the building.

The same procedure should be used in blocking out the large scale studies and the working drawings by first laying out the approximate location of the outside walls, then the boundaries of the units, then the individual room outlines, and finally the details of the plan, such as door and window locations, columns, vents, kitchen equipment, bath fixtures and so on. If the building is of a type that contains many similar units it is very helpful to study the individual units at a larger scale before incorporating the details of arrangement into the layout of the whole building.

The perspective studies of the exterior help fix window locations and certain structural features and guard against the necessity of having to change these elements later, which is liable to occur if this study is deferred until a later stage. Such studies are also very helpful in enabling the client to visualize his building and in obtaining his approval of all phases of the design before the working drawings are started. This is important from a standpoint of drafting room efficiency as it makes for a smoothly functioning job and avoids changes being made during the working drawing stage, which is much more costly and difficult than making changes during the sketch stage.

It is also important at this stage to prepare an outline specification of the materials,

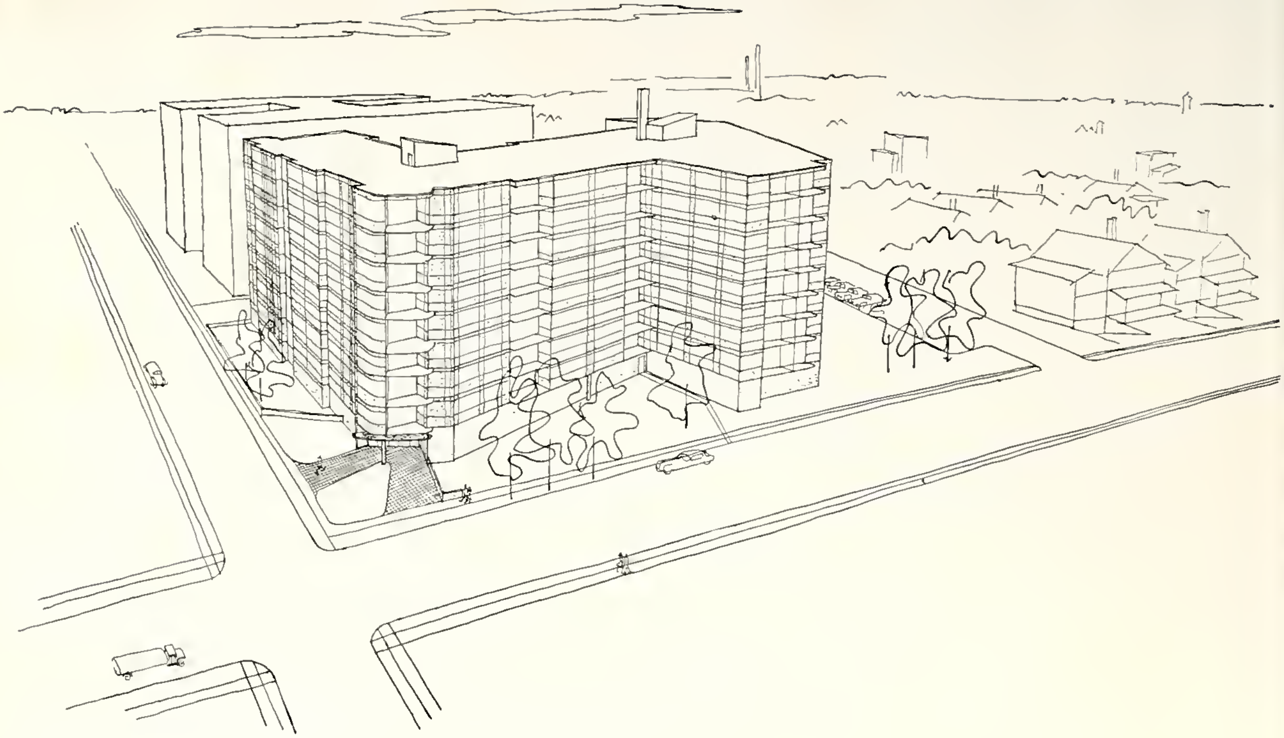


Fig. 121.

finishes, etc., to be used in the building as many of these items will have an important effect on the drawings. Such items as soundproofing, mechanical ventilation, air conditioning, type of structural frame, etc., have to be considered in the early stages so that provisions for them may be readily incorporated in the working drawings.

Free Shapes

The building discussed above was on a small site and of necessity the building shape was compelled to conform to the lot and restriction lines, hence the problem was one of fitting the apartment units into a predetermined building shape. The problem of designing a building or group of buildings on a site of large size in which the buildings stand free of the lot lines is quite different. It might seem at first glance that the problem would be easier, but, as a matter of fact, the very lack of restriction of the building shape makes the problem more difficult because the number of possible schemes is much greater.

If the project is to consist of 2 or 3 story buildings or a combination of the two, it is necessary to start by designing the individual buildings that will be used. The individual buildings will be comparatively small, usually of a group type plan, and in any one project the number of different buildings used is usually restricted to not more than three or four different types, which are planned to work in combination with each other. (See further discussion later in this chapter under the heading "Grouped Plans.") After deciding on the building types to be used it is then a matter of site planning to arrange them in proper combination on the site. The question of site planning will be discussed in Chapter 5.

If the buildings to be designed are multi-story elevator buildings many other factors enter the picture.

1. Number of buildings. This will be determined largely by site planning consider-

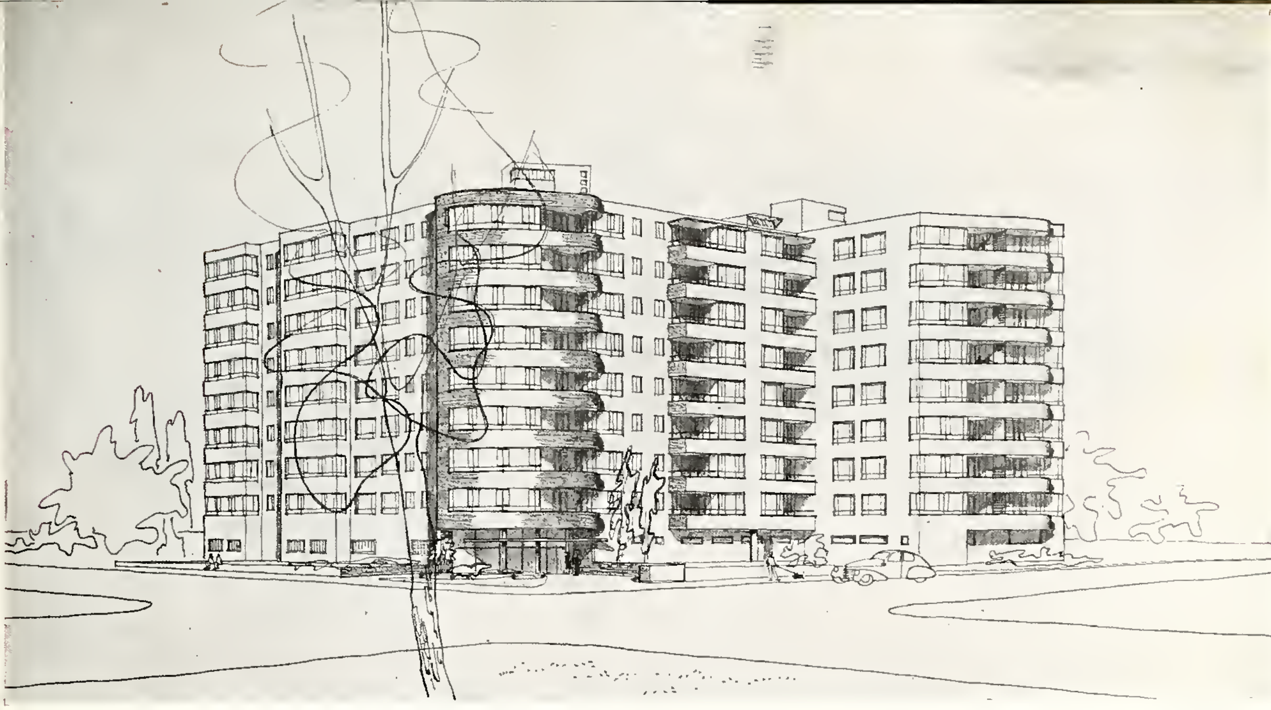


Fig. 122.

Fig. 123.

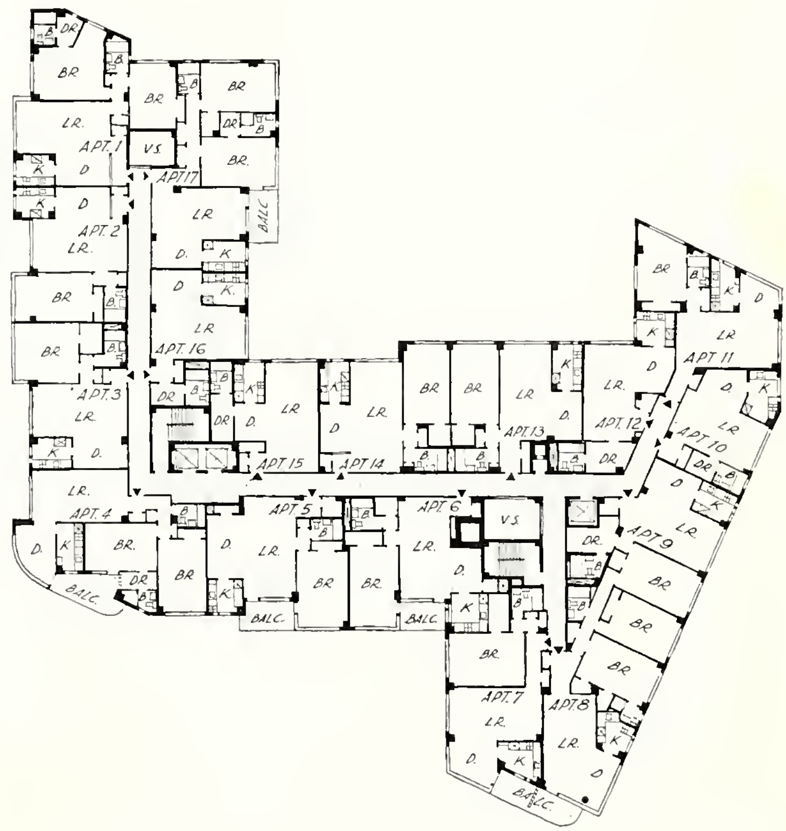


Fig. 125.

Fig. 124.

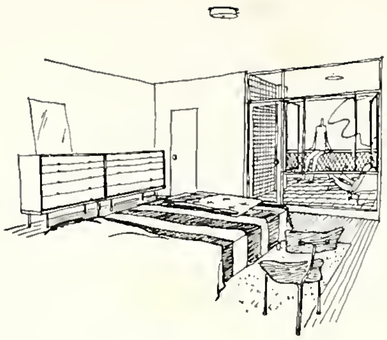


Fig. 126.

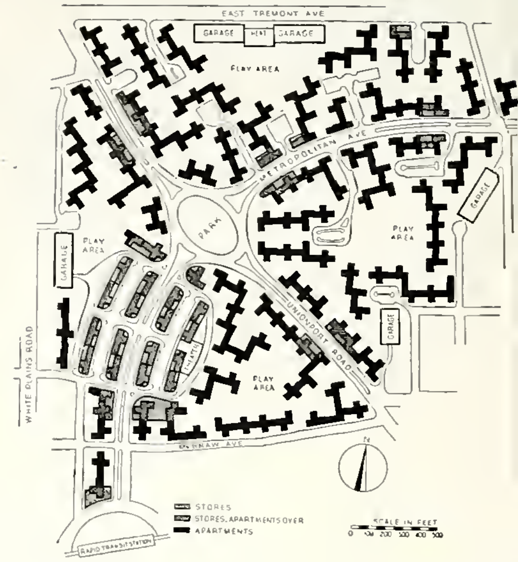


Fig. 127. Plot plan and typical floor plans for Parkchester Apartments, New York City, Metropolitan Life Insurance Company Board of Design, Richmond H. Schreve, Chairman, architect.

ations, such as amount of land available in relation to required population density, orientation, views, and effect of building bulk.

2. Number of building cores. The number of cores to be provided will depend on unit plan requirements, building height, and economical use of elevators. Elevators should run in pairs, in order to maintain service if repairs are required. Usual design standards for elevator service require that one elevator should serve about 400 people under peak load conditions. This standard is most nearly reached when each 100 to 125 apartment units above the first floor have access to two elevators. (For a further discussion see Section on Elevators).

3. Number of stories. The determination of the number of stories is related to the number of cores necessary for obtaining efficient use of elevators, stairs, incinerators, and other facilities. It is also affected by local zoning ordinances, foundation conditions, and site planning considerations.

For instance, if the maximum permissible building height at the proposed location is eight stories, then 16 apartments per floor per building core would result in 128 apartments per core. The 16 first floor units would not require elevator service and would be subtracted from the total units served. This would leave 112 units to be served by the two elevators.

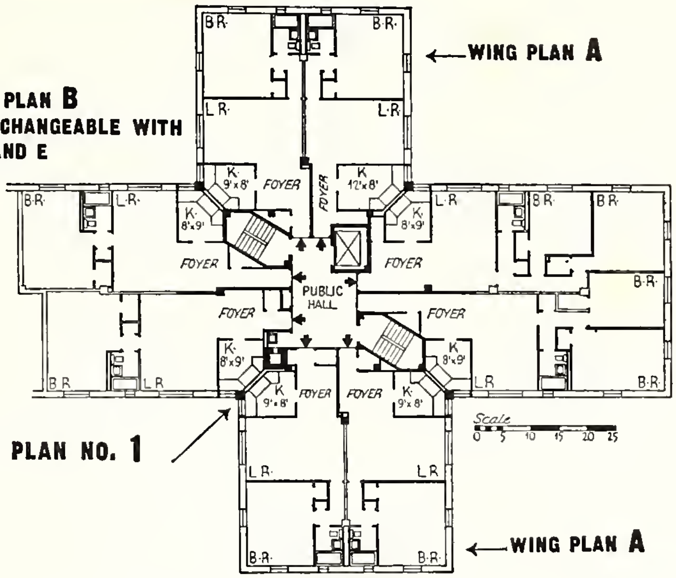
If the building height is not limited, and it is decided to build, say, a 13 story building, then 10 units per core per floor would give 120 units above the first floor served by the pair of elevators.

Two elevators apportioned as above are sufficient in most buildings for the handling of passengers, deliveries from stores, and the moving of furniture. Where planning

WING PLAN A

WING PLAN B
INTERCHANGEABLE WITH
C, D AND E

WING PLAN E
INTERCHANGEABLE WITH
B, C AND D

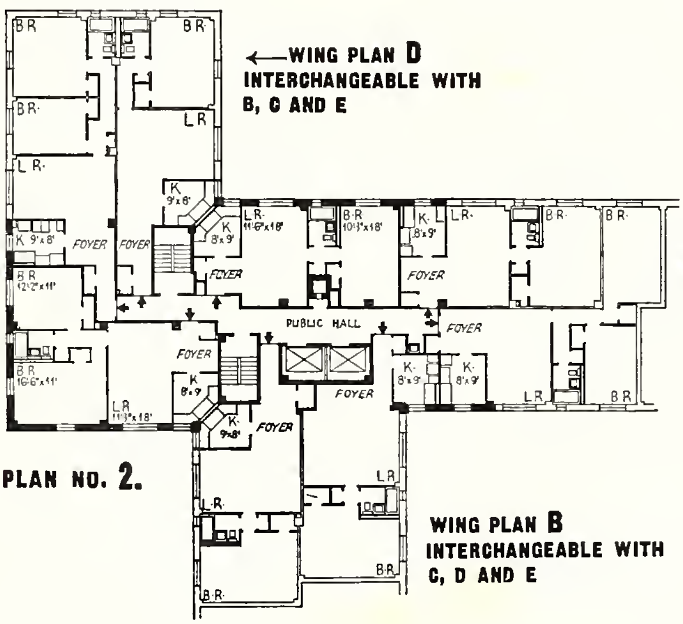


CORE PLAN NO. 1

WING PLAN A

WING PLAN D
INTERCHANGEABLE WITH
B, C AND E

WING PLAN C
INTERCHANGEABLE WITH
B, D AND E



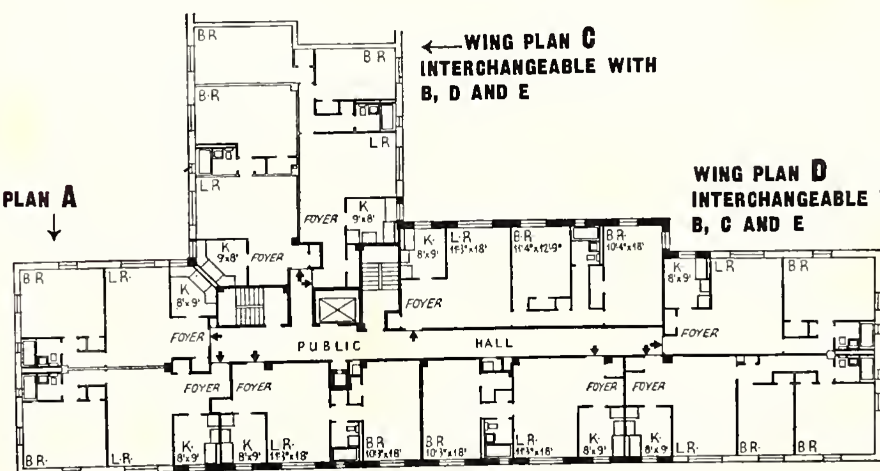
CORE PLAN NO. 2.

WING PLAN B
INTERCHANGEABLE WITH
C, D AND E

WING PLAN C
INTERCHANGEABLE WITH
B, D AND E

WING PLAN A

WING PLAN D
INTERCHANGEABLE WITH
B, C AND E



CORE PLAN NO. 3

conditions result in the necessity of more apartments per building core, one elevator is usually provided for each 45 to 60 units, depending on the character of service desired.

4. Design of core and wing plans. Standardization of core and wing plans in large projects has an important effect on building economy. It greatly simplifies building, design and drafting problems. Duplication of units facilitates the design and ordering of equipment, and the repetition of construction details promotes labor efficiency in the field and simplifies the problems of supervision of construction.

The plans of Parkchester in the Bronx, N.Y., by a board of design headed by Richmond H. Shreve, architect, present a good example of this sort of standardization. This group consists of 51 buildings, composed of 171 building units. All of these units are formed by the use of only three different core plans and five interchangeable wing plans, as shown in Fig. 127. Each building is made up of varying combinations of these units, which can be combined in an almost infinite number of ways. In addition, it should be noted that all bathroom layouts are identical and there are only three different kitchen layouts used. The site plan (Fig. 127) shows a number of the possible combinations of unit plans.

Comparative Analysis of Free Plan Study

The following sketches are presented in an effort to demonstrate, by means of a typical example, the methods of comparing various schemes for an apartment project, and to afford opportunity for discussion of various factors affecting building design. Due to the complex interplay of the many factors affecting building design, construction, and cost, it must be emphasized again that figures, as given in the following example, are valid only in comparing projects having units containing the same or nearly the same number of rooms and having rooms of the same size. For instance, a reduction of area of say 10% in the room sizes in the units of the projects presented here would result in a very different ratio of building area to corridor, stair, and elevator space, because the building core would remain almost the same throughout a wide variation in room size, assuming that the basic plan layout was the same. Furthermore, the building cost would not vary in direct proportion to the reduction of room size because the cost of most of the expensive building components, such as stairs, elevators, incinerators, baths, kitchens, etc., would remain the same. The prevailing practice of comparing building costs on the square foot or cubic foot basis can be extremely misleading. Given two buildings of the same cubage, one containing all efficiency units and small rooms, and the other containing bedroom units and larger rooms, the per cube price of the first building will be much greater than that of the second. This is an extreme example, but the same principle applies to a degree in any comparison of two different buildings. The only really valid method of comparing costs is on the basis of an actual estimate made by a competent building estimator and quantity surveyor on the basis of complete plans.

Figures 128 to 132 inclusive show a series of studies made in the office of Berla & Abel, architects, for an apartment building to be located on a site of such size that the shape of the lot had no effect on the shape of the building. In such cases the best building shape is that which approaches a simple rectangle. It was decided to experiment with various widely differing schemes, attempting to eliminate as many corridors as possible, and at the same time maintaining elevator efficiency, with the further stipulation that in case of elevator breakdown no tenant should have to walk up or down more than one flight.

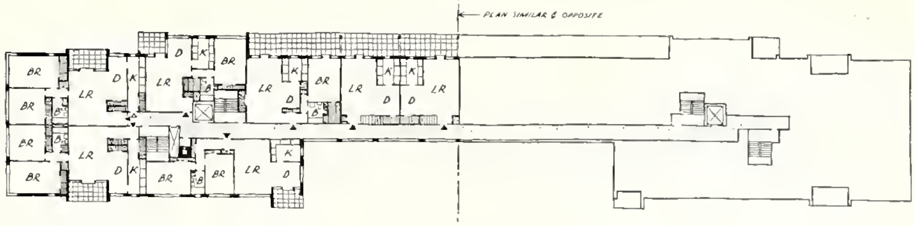


Fig. 128. *Project A—Floors 1, 4, 7*

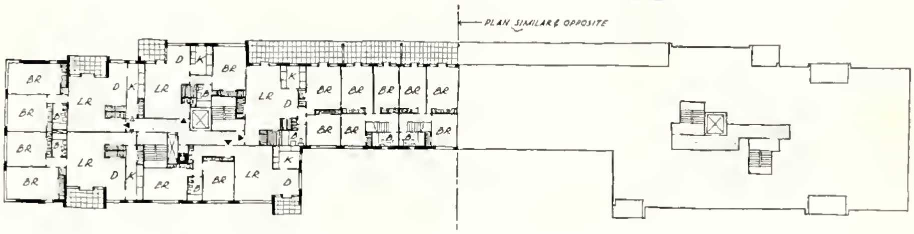


Fig. 129. *Project A—Floors 2, 3, 6*

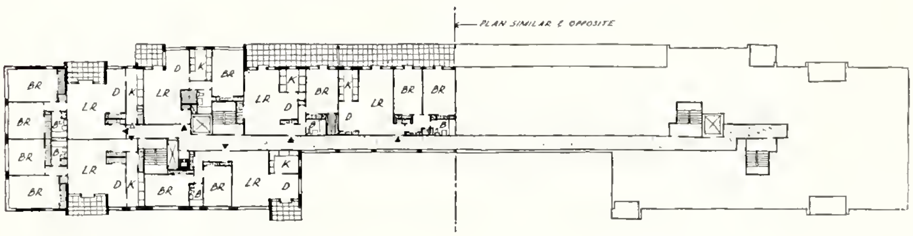


Fig. 130. *Project B—Floors 1, 4, 7*

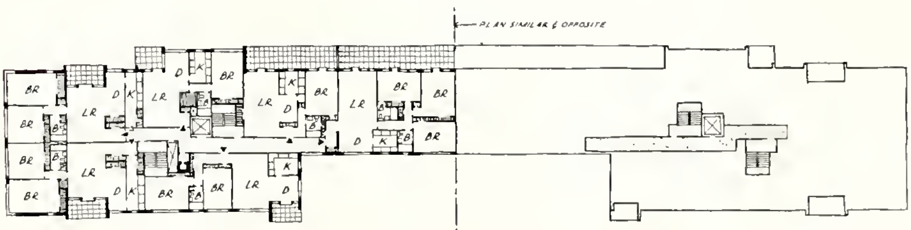


Fig. 131. *Project B—Floors 2, 3, 5. 6, 8*
Project A—Floors 5 and 8

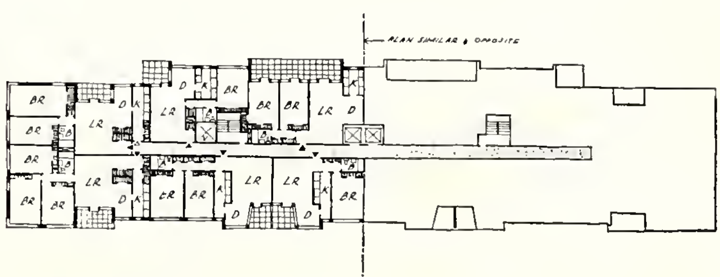


Fig. 132. *Project C—Floors 1 to 8 inclusive*

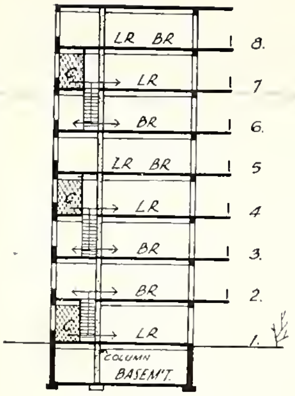


Fig. 133. *Section, Project A*

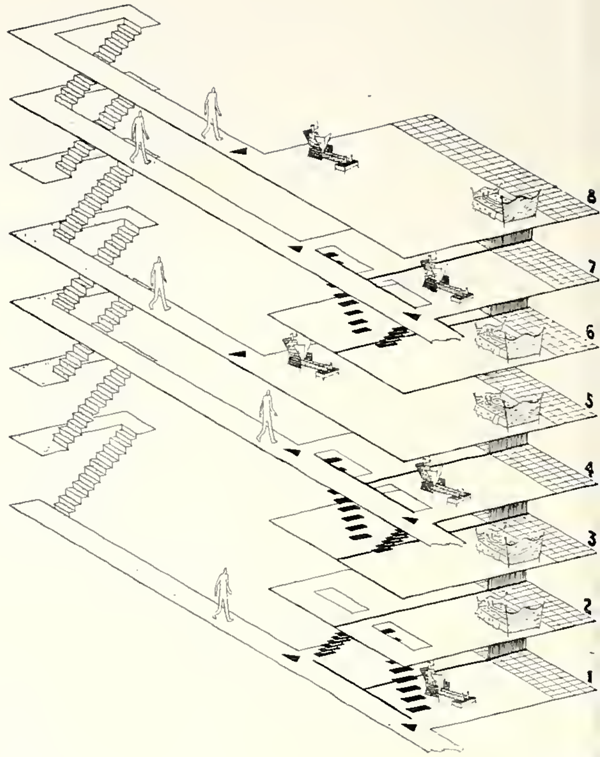


Fig. 134

Study of building sections showed that this requirement could be met in projects A and B by use of corridors on floors one, four, and seven (Figs. 133, 134, 135). In project A floors five and eight are the same plan as floors two to eight in project B. All apartments in all three schemes have balconies, and room sizes and number of rooms were made as nearly the same as possible to afford as close a comparison as could be made of the three schemes. In computing the areas for projects A and B the areas of the continuous central balconies were omitted, and an allowance of 100 square feet per unit added for balconies for the abutting apartments, as it was felt that this would give a fairer comparison with project C. Project C is a corridor building of conventional type, and all floors are the same, except for an allowance on the first floor for lobby space (Fig. 136). Figure 138 shows a roughly blocked out diagrammatic perspective of projects A and B; Fig. 137 a sketch of the balconies. The table shows the comparative area and wall perimeter data for all three schemes.

	1	2	3	Gross Area		6	7	8	9
Project	Apts.	Rooms	Perimeter per Room	4 Per Apt.	5 Per Rm.	Total Floor Area	Total Perimeter	Area of Corridors, Stairs, Elevators	% Col. 6–8
A	96	408	16.27	1184	278.6	113,696	6640	10,316	9.07
B	96	399	16.60	1184	285.0	113,696	6640	11,156	9.80
C	96	406	14.10	1134	268.2	108,896	5744	8,920	8.19

Note that in projects A and B the gross area per room, the perimeter per room, and the area required for corridors, stairs, and elevators are all greater than in

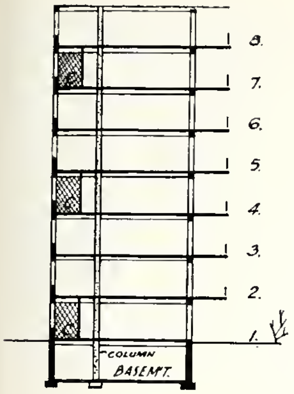


Fig. 135. *Section, Project B*

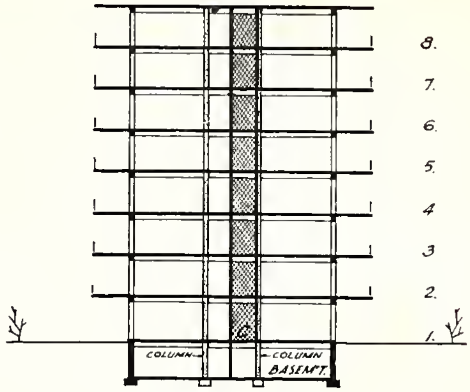


Fig. 136. *Section, Project C*

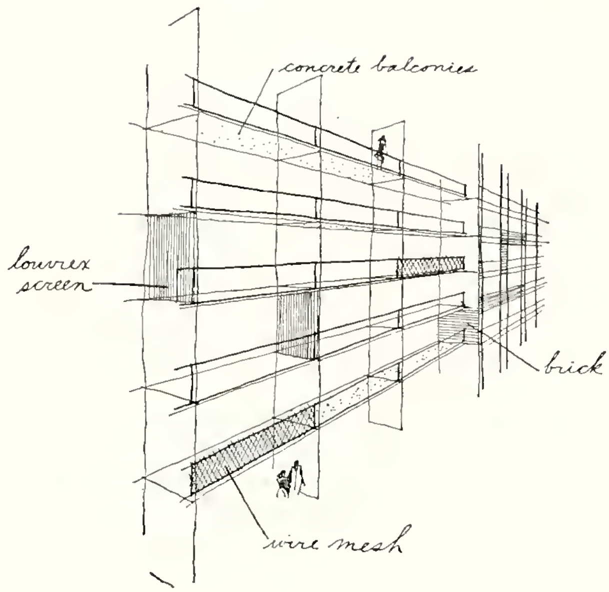
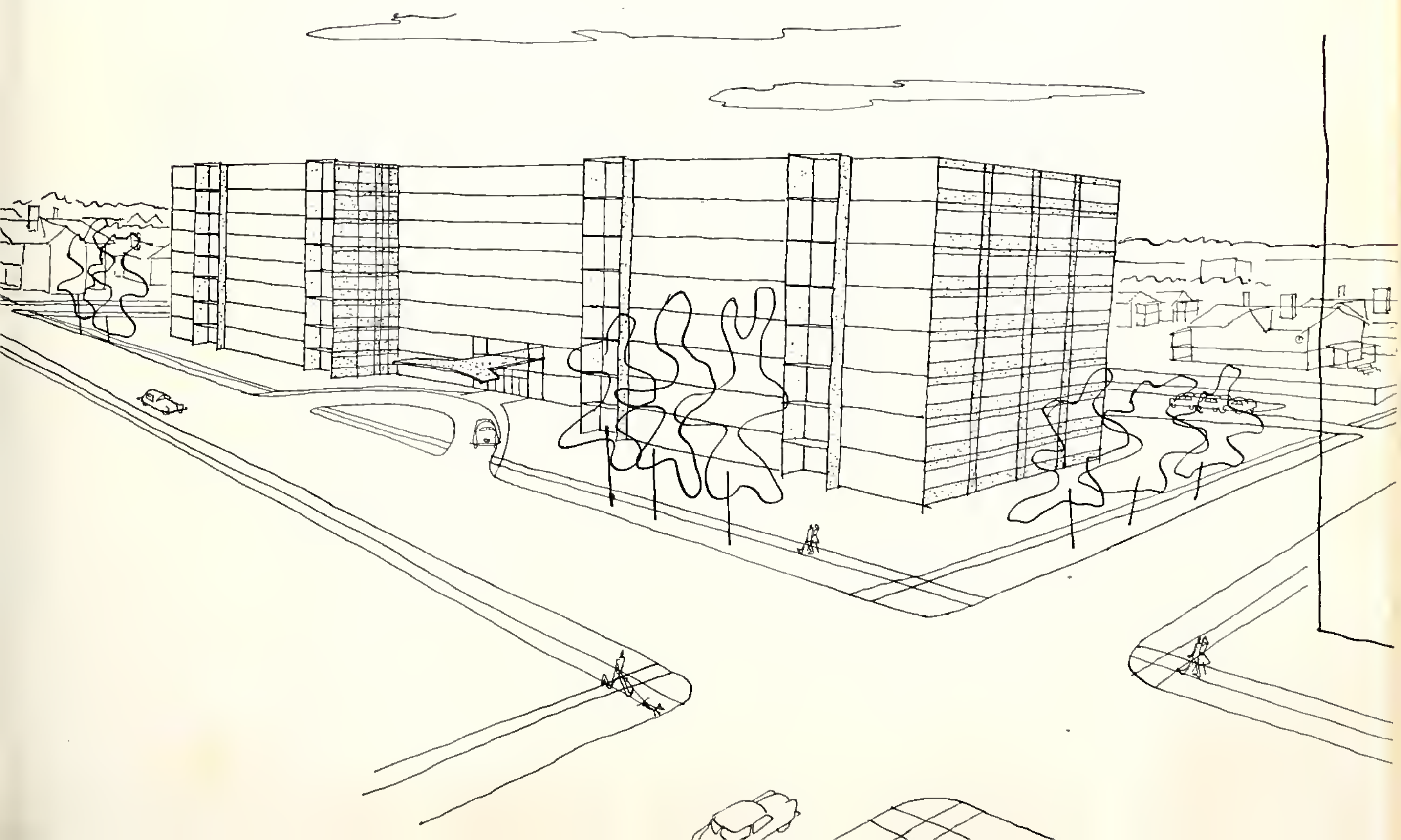


Fig. 137.

Fig. 138.



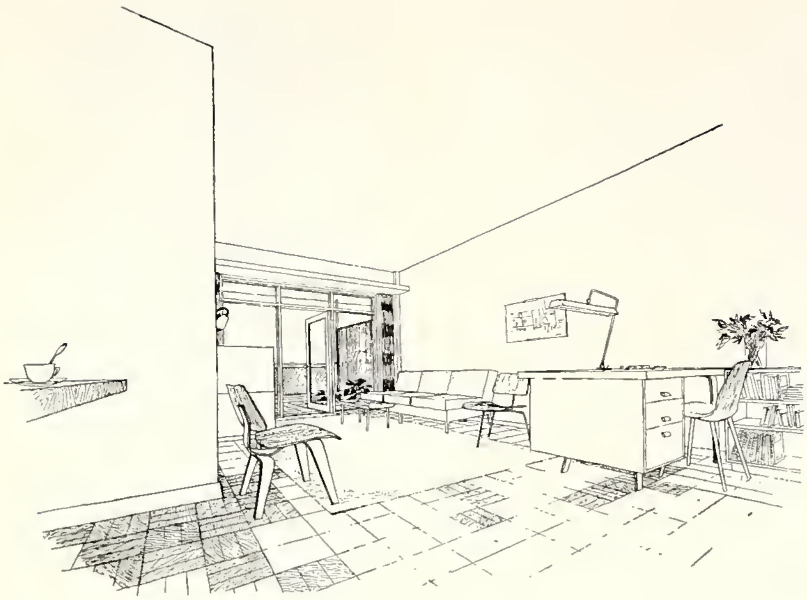


Fig. 139.

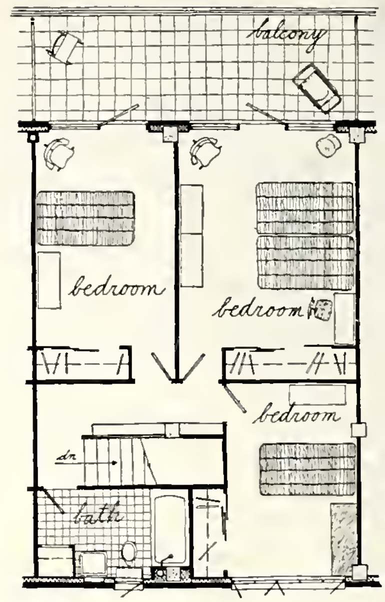


Fig. 140.

project C. This is due to the fact that in projects A and B two stairs are required at each end of the building to comply with local building regulations, and the fact that more length of corridor is required due to the increased building length necessary to obtain the required number of units per floor. It has not been possible at this time to obtain accurate cost estimates on these three schemes, and variations in area do not always give a corresponding variation in building cost, but all other considerations being equal, the probabilities are that in this case project C would cost considerably less per unit than projects A and B. In addition to increased areas, the following factors must also be considered as affecting the construction cost: In projects A and B the variations in plan of different floors make the layout of columns and beams more difficult and complicated and may lead to the necessity for a more costly building frame. The same considerations apply to the layout of plumbing stacks and the ducts for mechanically ventilating the baths. In project A the cost of additional stairs inside of the duplex units would also add to the cost.

Note that the end units in each scheme are very nearly the same, so that any discussion of the relative merits of the three schemes must focus on the center units. In project A the duplex units would give a quality of space approximating that obtained in a small row house. Figures 140 and 141 show the plan of this duplex in more detail. Figure 139 is a perspective of a typical living room, looking toward the exterior wall. Figure 142 is a perspective study showing the duplex apartment with the front wall removed. This study gives a fair idea of the quality of space obtained with this design. Whether the prospective tenant would prefer a duplex to a similar number of rooms on one floor as provided in project B is open to some doubt. A liking for everything on one floor is evidenced by the increasing popularity of one story houses.

In project B the center units gain the advantage of having two baths, a desirable

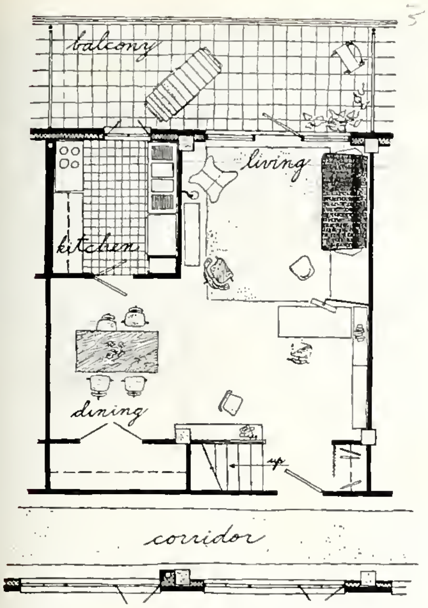


Fig. 141.

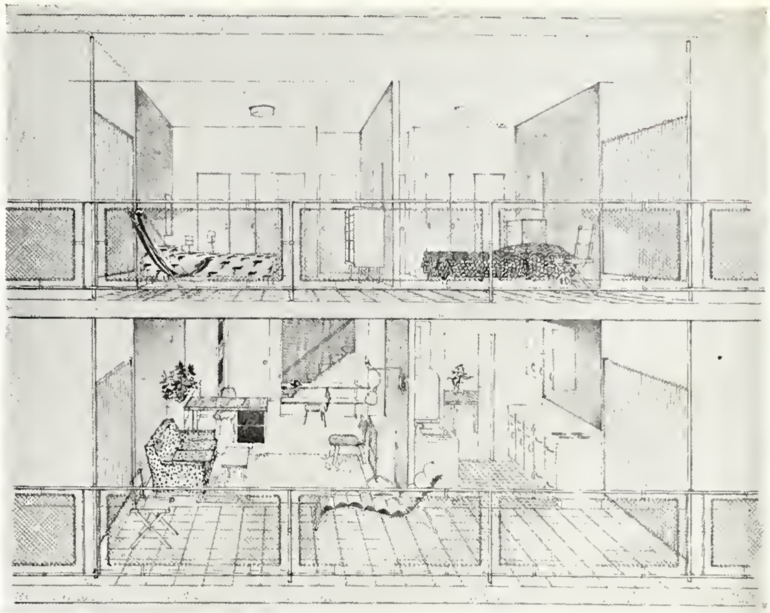


Fig. 142.

amenity in conjunction with three bedrooms, and the continuous sweep through the building of the living and dining space would give a feeling of spaciousness and a good distribution of light. Although most units in projects A and B have through or corner ventilation it was felt that in order to assure good air circulation mechanical ventilation should also be provided.

In project C the center units are of more conventional type. However, with their balconies and large glass areas, they would present an attractive air of spaciousness and the open dining areas in conjunction with the living rooms would relieve any feeling of boxiness that would result from the use of purely rectangular rooms. The general appearance of the living and dining space would be about as indicated in Fig. 139. The probabilities are that the cost of project C would be sufficiently less than that of projects A and B, that if desired, complete air conditioning could be supplied at a per room cost no greater than the per room cost of projects A and B without air conditioning. This could not, however, be done without an increase in rent as the cost of operation and maintenance of air conditioning equipment is considerable.

Grouped Plans

Plans in which from two to four units are grouped around a single stairway are used mainly for garden apartment buildings. The following diagrammatic layouts show the plan types most frequently used. Groups of five apartments around a single stair are possible for single buildings, but will not combine with other buildings for efficient use in groups of buildings. The lines through the units indicate the possible air flow through the units. The strip plan shown in Fig. 143, Scheme A, gives two units per stair with through ventilation. The strip plan shown in Scheme B allows three units per stair with one unit getting through ventilation through the stair hall. This type is not approved by the FHA for projects insured under Title 608. Scheme C shows a group of four units per floor each having corner ventilation and

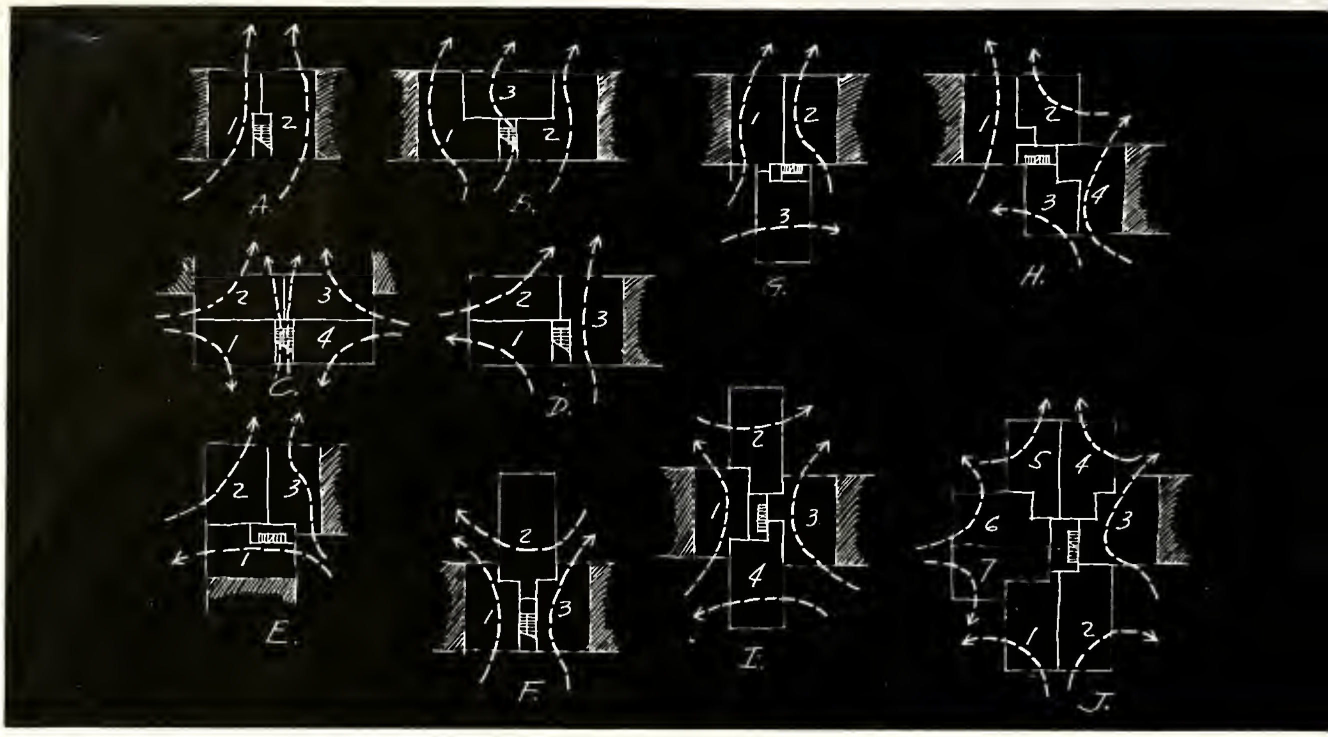


Fig. 143.

this type also is not FHA approved. Scheme D is a strip unit suitable for the end building of a row having three units per stair. Schemes E–J show a variety of other possible groupings which may be used in combination with strip plans. The zee shape shown in Scheme H is difficul tto work out efficiently and the cross shape in Scheme I is probably the most expensive per room due to the excessive outside wall perimeter required. The cross shown in Scheme J has too many units with corner ventilation only, for FHA approval. Schemes K–N show various possible combinations of units. By a judicious combination of types, groups of practically any desired shape may be had to fit lot requirements.

A maximum lot coverage of 25 to 30% will give good results with this type of group provided that the other elements of good site planning are complied with. Open spaces should be concentrated in large areas properly related to the buildings and not be scattered at random through the project. Narrow, long courts should be avoided, proper spaces between buildings should be preserved, and building orientation should be carefully considered. Requirements that plans be laid out to provide through ventilation for all apartments do not gain their desired objective unless the buildings are placed so as to actually take advantage of prevailing breezes. Such a statement seems to be absurdly obvious, yet an examination of many site plans of such projects, as actually built, will show that the matter of orientation has been very frequently neglected. Too many plans seem to have been concerned with a striving for a formal plan that will give an attractive pattern on paper, rather than with a real concern for actual living quality in the units themselves.

Another factor to be borne in mind is that the greatest economy is to be obtained in this type of building through a striving for simplicity, both in the units and their larger groupings. Complicated plans result in waste space that nullifies all the advantages inherent in this type of plan. In general, the fewer varieties of building

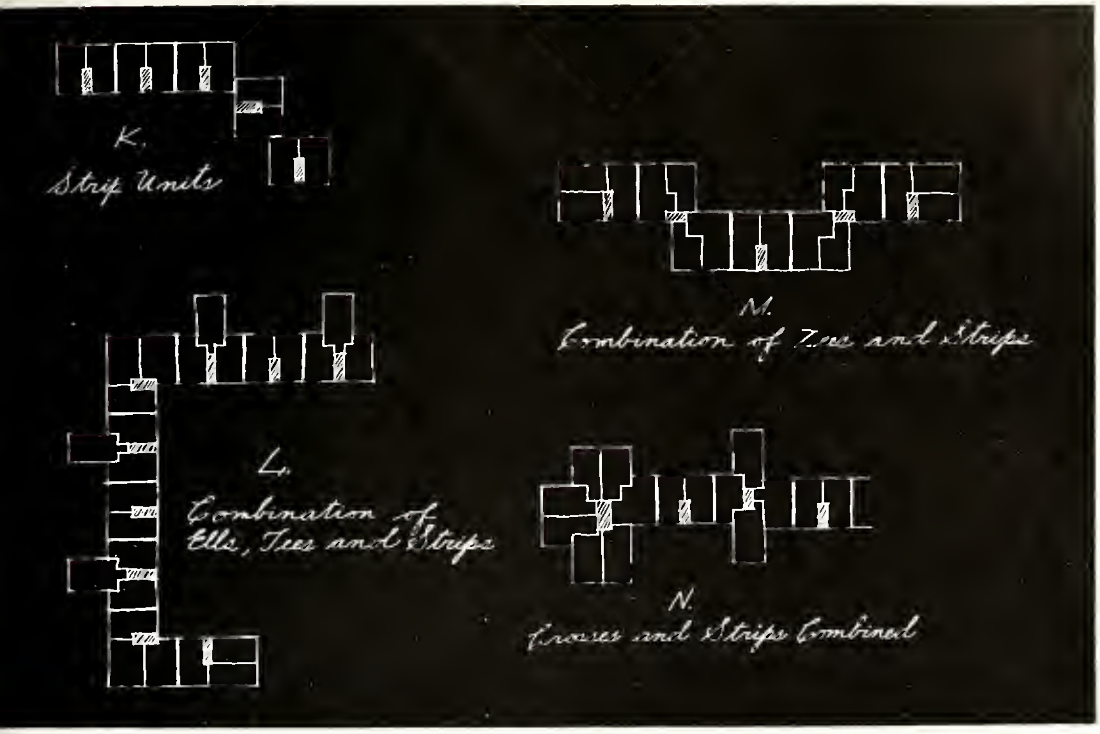


Fig. 144.

shapes that are used, the better they are from a standpoint of efficiency and economy. Excessive breaks in plan, complicated groupings, and breaks in walls purely for "architectural effect" should be avoided. Interest may sometimes be added by varying building mass in following sloping contours or by using buildings of varying heights. Some projects, consisting mainly of two story buildings have introduced a few three story units at judicious intervals. Group type plans have also been successfully used in combination with duplex units (see plans of Falkland, Chapter 3). Another frequently used method of varying building bulk has been through the combination of flat and pitched roofs. In my opinion the excessive use of pitched roofs on apartment buildings is uneconomical and the results obtained from a standpoint of appearance do not justify the cost. The money spent for the many acres of such roofs which have been built could have been used to much better advantage elsewhere on the projects in providing facilities the tenants could actually use. The visual effect of such roofs when used throughout a project is just as monotonous as making everything flat and level.

Working Drawing Considerations

Before proceeding with working drawings a thorough check of local building code provisions applicable to the proposed building should be made, and any points in doubt should be discussed with the officials in charge. A little time spent on this phase may save much time and trouble later, the present form of most codes makes the ferreting out of all the complicated requirements applicable to multiple dwellings a very difficult task, especially, as is frequently the case, when various interpretations of code provisions have been made over a long period of time without ever having been embodied in written revisions.

The mechanical engineer should have been consulted as suggested, in the earlier sketch stages, so that at this point the type of heating system can be decided on and calculations made to determine flue size, space required for heating equipment

and fuel storage, and riser locations can be established. The ventilating system should be designed, duct sizes established, and fan room locations and sizes determined. The plumbing system should be laid out and soil, waste, and down spout locations fixed. The roof plan should also be studied and spaces allocated for penthouses, roof gardens, radio aerials, etc. Sizes of elevator shafts should be checked, height of penthouse and depth of pits required need to be determined, and elevator loads carried by the building frame should be obtained and furnished to the structural engineer. Every bit of information that it is possible to obtain, and every requirement that can be fixed at this time, will prove a time saver in the making of completed plans and specifications.

In this connection it should be mentioned that the architect inexperienced in this type of work would find it of great value to obtain the services of a consultant architect familiar with all phases of apartment work. Such a consultant should be able through an intimate knowledge of the problems involved to save the cost of his fee by speeding up both the design and working drawing stages of the work, and by avoiding costly errors that might otherwise be encountered. In addition, competent advice on such matters as financial set ups, selection of equipment and materials, and zoning and building code requirements is well worth while. It is worth noting in this connection that many large projects of the type built by the various housing authorities sponsored by the U.S. Government and by insurance companies have been designed by boards of design composed of experts in all fields relevant to the purpose. Such boards are usually composed of a chief architect, with several other architects, engineers, builders, and financial experts working under his direction, each contributing his own special knowledge of his own field. The complexities encountered in the design and erection of very large projects are staggering and require expert knowledge and skills beyond the capacity of any one individual.

CHAPTER 5: Site Planning

The primary objective of site planning is to provide a project with a sound basis for the development of family life. This can be achieved only by a thorough study and correlation of all the various factors affecting the building or group of buildings from both an artistic and practical viewpoint. The factors affecting site selection have been discussed in Chapter 2. A check list of factors affecting site planning is given below.

Check List of Site Planning Factors

1. Topography

a. adjustment of buildings
b. adjustment of circulation
c. preservation of natural features

2. Orientation

a. sunlight
b. prevailing winds
c. views and outlook
d. relation of buildings to each other
   1. noise reflection
   2. privacy within units

3. Population Density

4. Circulation

a. external—project entrances in relation to
   1. mass transportation
   2. public highways and streets
   3. neighborhood facilities

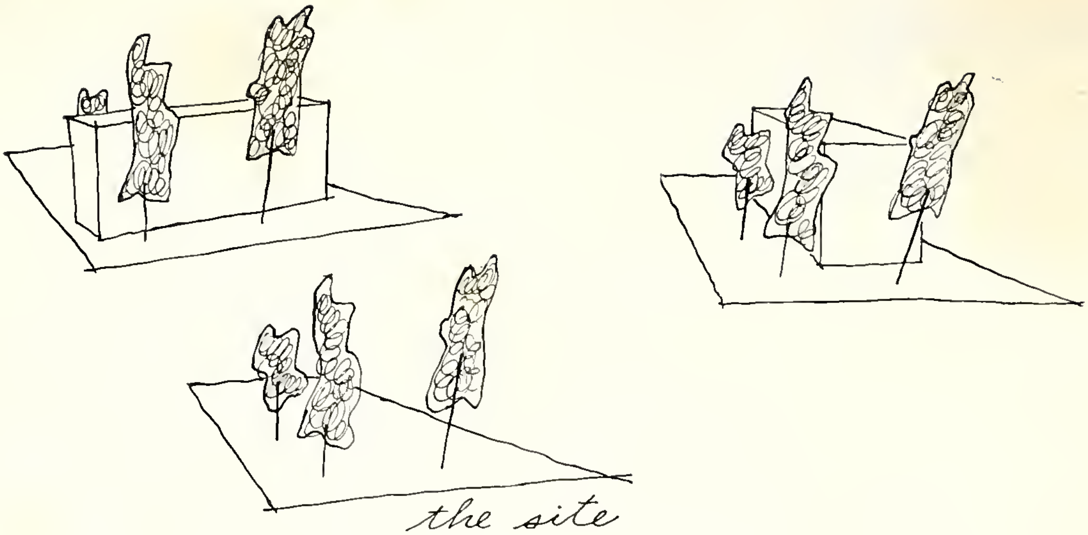


Fig. 145.

b. internal—project roads and walks in relation to
   1. building entrances (public and service)
   2. control
   3. vehicular access
      a. mail delivery
      b. fire department and police department
      c. public parking and garages
      d. deliveries—fuel, moving vans, store deliveries, removal of ashes, trash, garbage

5. Landscaping

a. relation to buildings
b. relation to site
c. preservation of natural features
d. maintenance

6. Facilities

a. gardens
b. play spaces
c. car parking
d. community buildings
e. commercial buildings

Topography

A careful adjustment of buildings and circulation to existing ground conditions is essential both in the interests of building economy and the preservation of any existing natural features, such as groups of trees, rock formations, etc. (Fig. 145). On a rugged or steeply sloping site, in particular, the ignoring of existing ground conformation will cause excessive grading costs. The main objectives to be sought in designing the grading for a project are to create suitable and economical building sites, to carry off and dispose of surface water, to fit each part of the site as perfectly as possible to its proposed use, to keep maintenance costs as low as possible, and to create a pleasing appearance.

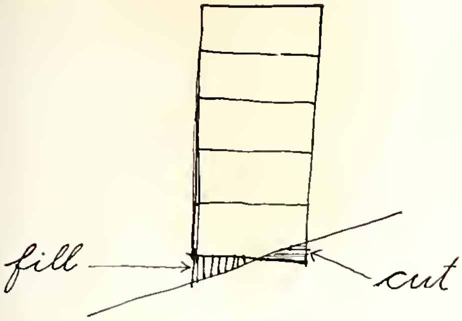


Fig. 146.

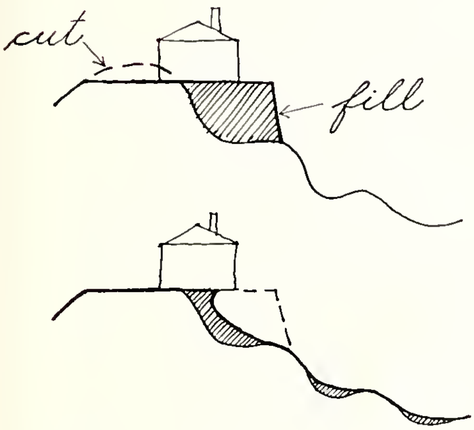
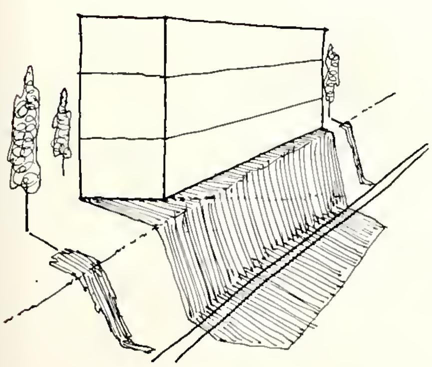


Fig. 147.

Fig. 148.



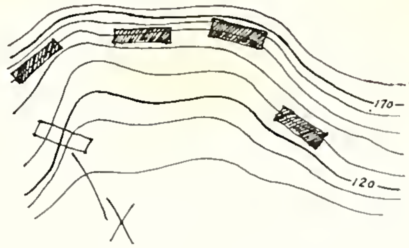


Fig. 149.

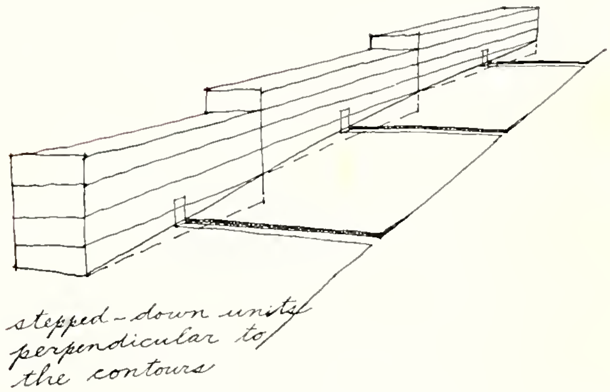


Fig. 150

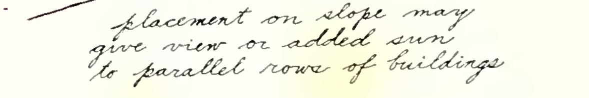
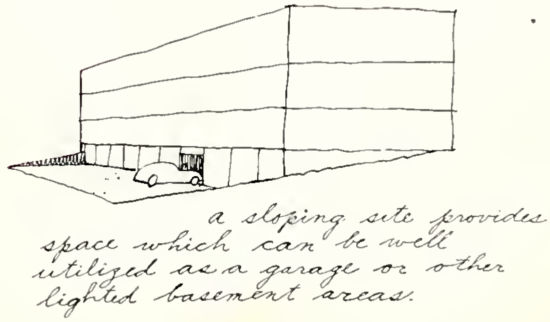


Fig. 151.

Fig. 152.



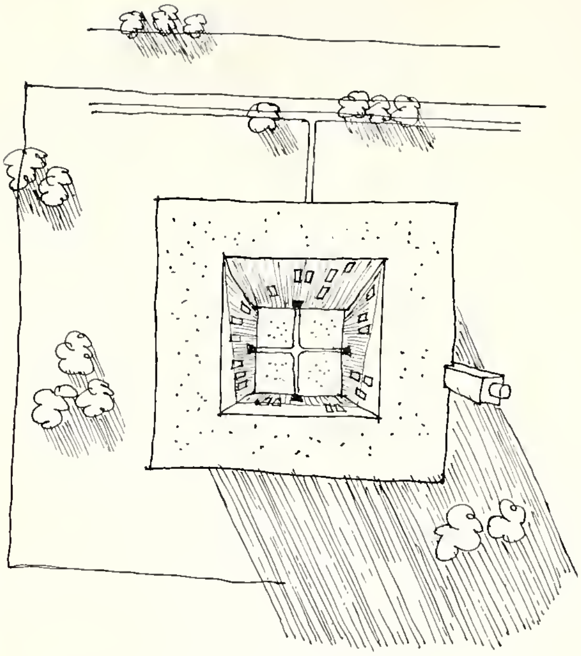


Fig. 153.

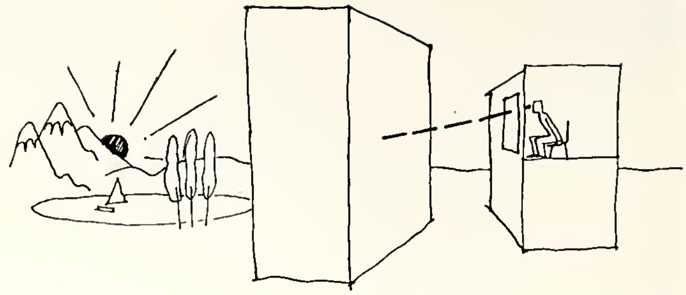


Fig. 154.

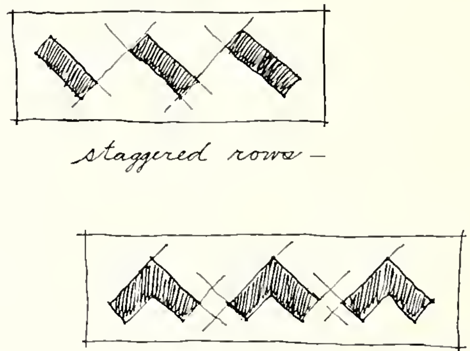


Fig. 155.

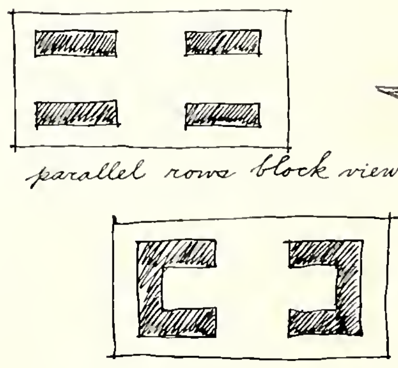


Fig. 156.

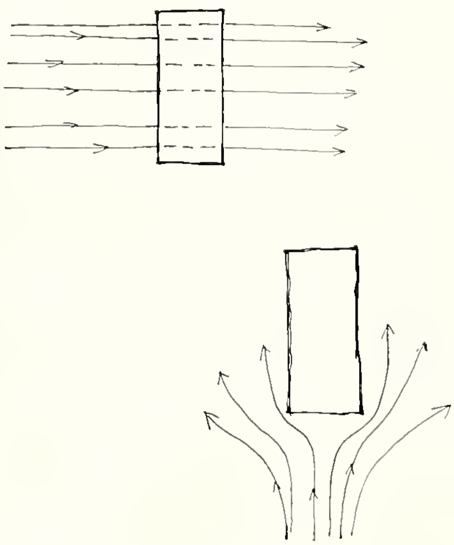


Fig. 157.

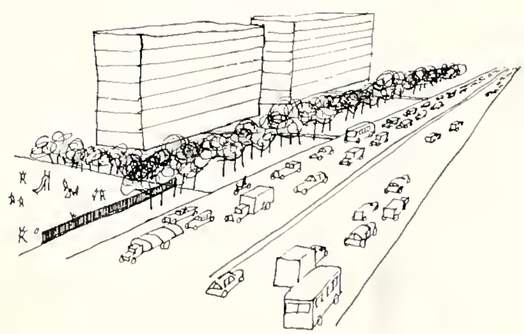
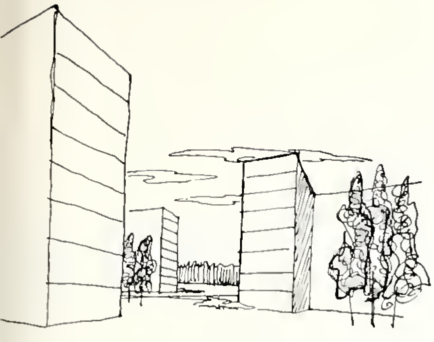
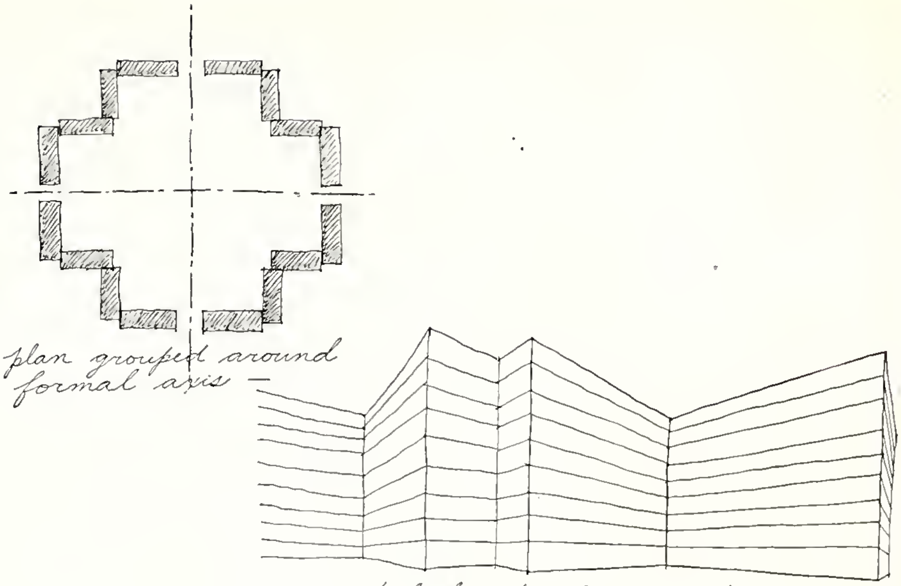


Fig. 158.



open spaces permit view of sky and good landscaping, relieves shut-in feeling

Fig. 159.



plan grouped around formal axis —

as it looks to the pedestrian

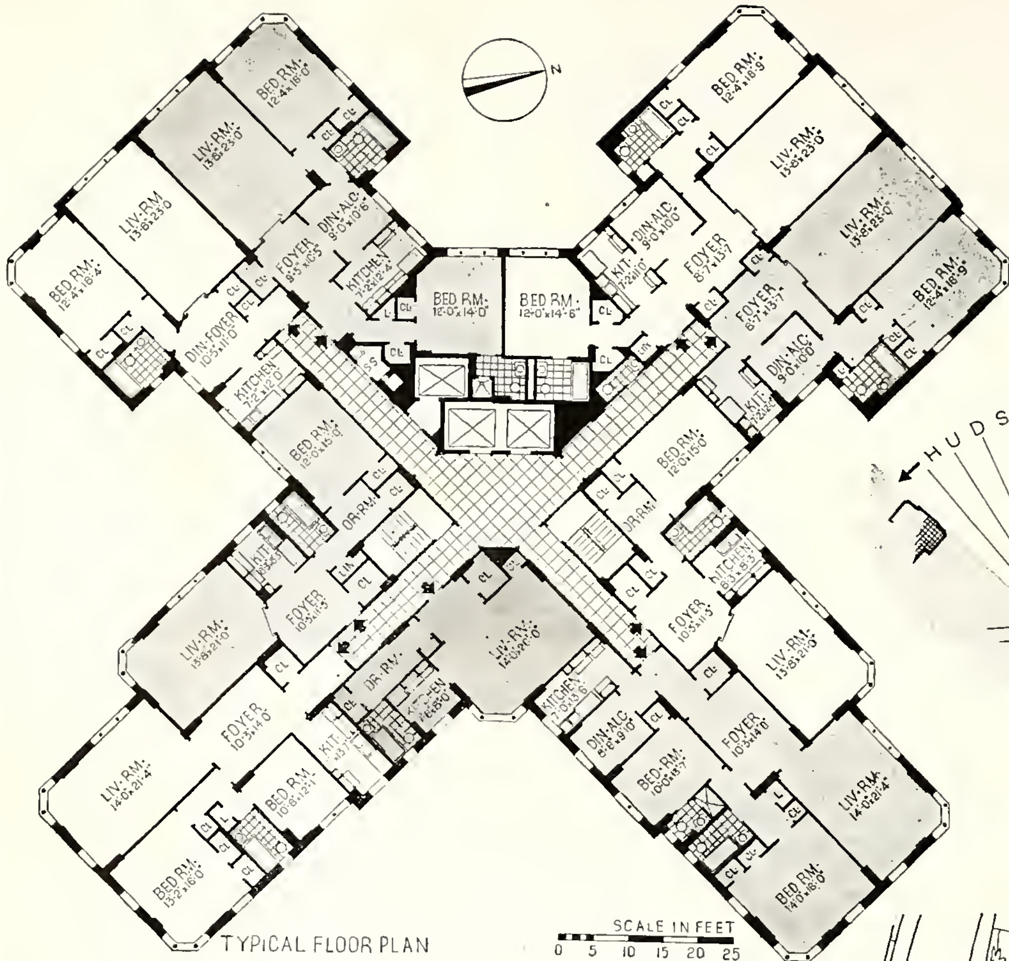
Fig. 160.

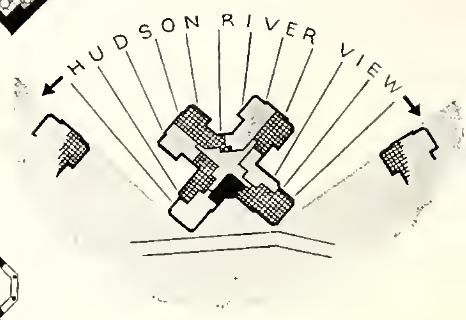
In the interest of economy cut and fill should balance as nearly as possible (Fig. 146), although sites will be encountered where this cannot be done. With modern earth-moving machinery the costs of grading, even when large amounts of earth must be moved, are not so great as to cause the rejection of otherwise good sites for this reason alone, nor is it good design to spoil the visual effect of a project merely to save a comparatively small amount of grading work (Fig. 148). High steep banks are not only unsightly but are also subject to erosion, which results in high maintenance costs (Fig. 147). Roads, walks, terraces, and all finish grading must be carefully thought out in relation to drainage problems in order to prevent erosion and to create useful and pleasant appearing spaces. It must be remembered that low first costs do not always result in economy in the long run.

Lawn areas should have a slope of not less than 1%, 25% is the maximum slope on which a mower can be used. Grassed play areas should not slope more than 4% as slopes in excess of this are not suitable for playing games. A slope of three to one is considered a reasonable slope for grassed banks and two to one is the maximum that can be expected to stay in place.

If there are good trees on the site an attempt should be made to plan grading so as to save as many of them as possible. If necessary, tree wells can be used where the grade must be raised, or elevated planting may sometimes be preserved by means of low retaining walls. Good trees contribute greatly to the appearance of a project and the effort to save as many of them as possible is well worth while. Earth fill should never be placed directly against existing trees as this will invariably kill them.

The relationship of the building or buildings themselves to the topography is very important. Figure 149 shows buildings placed parallel to the contours. For long narrow units this is the most economical placement, as it results in a minimum of foundation work. Figure 150 shows building units placed perpendicular to the con-





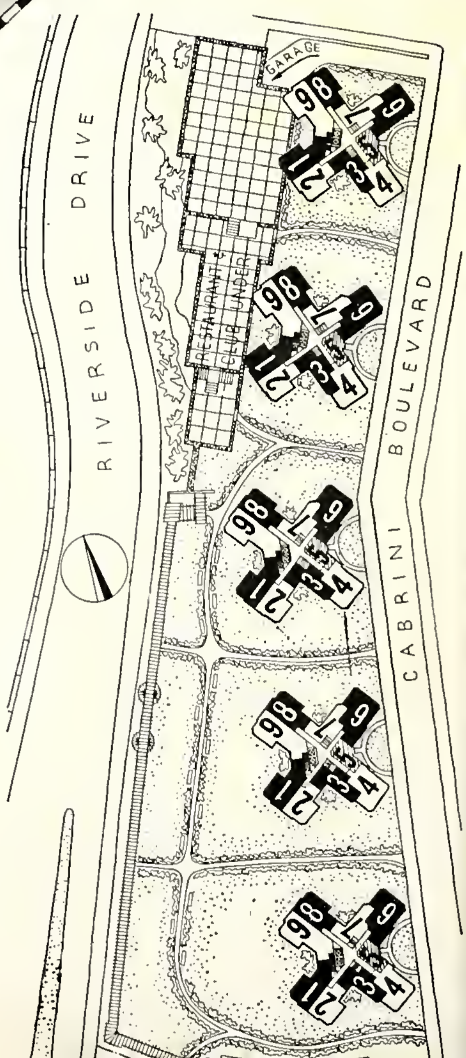


Fig. 161. Castle Village, New York City. George Fred Pelham, Jr., architect. An example of the trend toward superblock developments. The buildings cover only 20 per cent of the ground area and range in height from 11 to 13 stories. Note how the buildings are staggered to take advantage of the view of the Hudson River and the New Jersey Palisades. The project contains 569 apartment units arranged so that 512 of them have an unobstructed view. The garage, restaurant, and club unit shown on the site plan is entirely below the first floor and so does not obstruct the view from any of the apartments. The typical floor plans of the 5 buildings are identical. Architectural Forum.

F. S. Lincoln

Fig. 162.

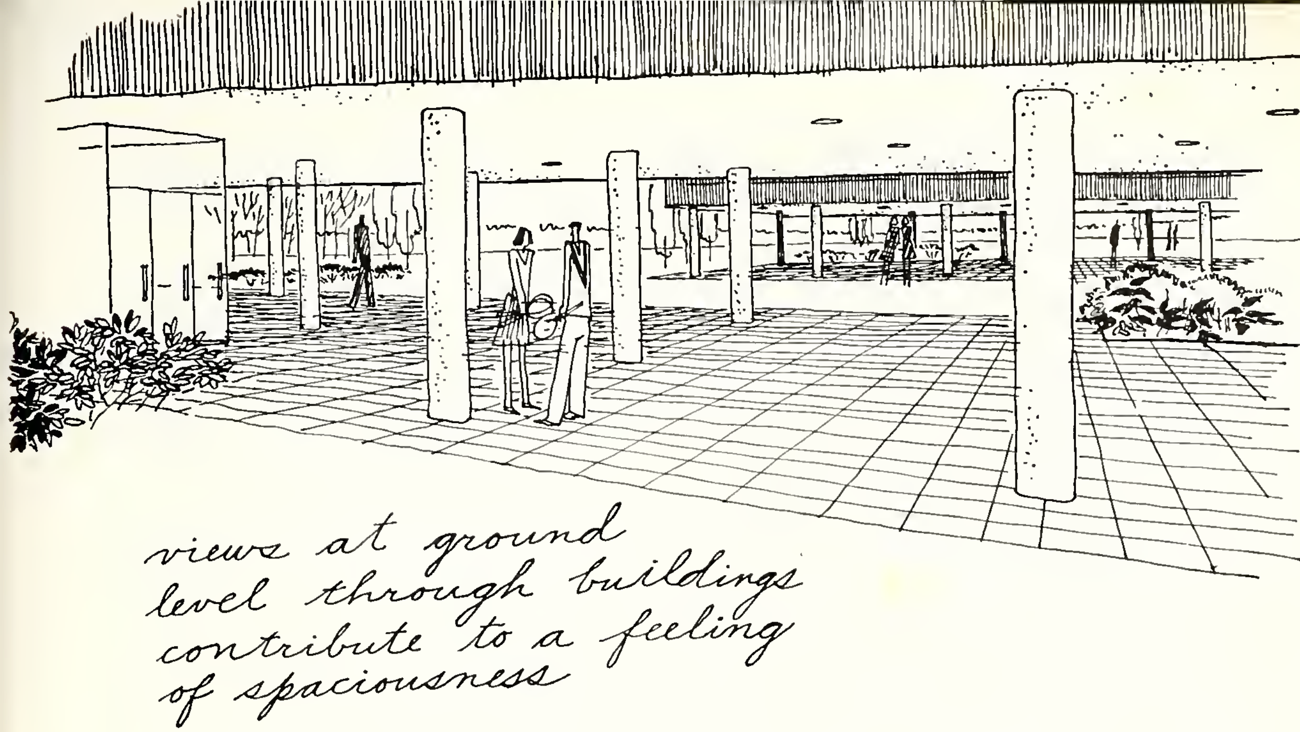


Fig. 163.

tours, each building being stepped down to follow the slope. This scheme is economical when buildings are short compared to the amount of slope and gives interesting variations in building silhouette. The choice between these schemes depends on the characteristics of the particular site in relation to the type of buildings being used, so that it is not possible to formulate any precise rules here.

Figure 151 shows how advantage may be taken of a slope to provide better orientation for buildings. The elevation of the building on the upper part of the slope permits more sun to reach the lower stories and gives a view past the lower building to the apartments in the upper stories. Figure 152 indicates how advantage may frequently be taken of a sloping site to provide accessible or well lighted basement space, which may be used for garages, recreation rooms, etc.

Orientation

Orientation of buildings in relation to sunlight is of more importance than orientation in respect to prevailing breezes. Rooms which face from 25 degrees east of south to 25 degrees west of south, in the central and northern latitudes of the United States, will receive the maximum sun in the winter and the minimum in the summer. Unless placement for prevailing breezes will coincide with orientation for sunlight it is preferable to place the buildings so that the maximum number of units will receive sun rather than breezes. In those cases where prevailing breezes can be utilized care must be taken to place the long side of the buildings toward the breeze (Fig. 157).

Where conditions are favorable, advantage should be taken of any possible views, and relation of the various buildings to each other should take this factor into account. Lack of care in placement of one building may block the view of several others (Fig. 154). The proper relation of buildings to each other is a matter of extreme importance and is one over which the architect can exercise the greatest control. Where possible, buildings should be staggered to take advantage of views and to avoid giving the tenant a view from his window of nothing but another apartment building (Figs. 155, 161). Completely enclosed courts should never

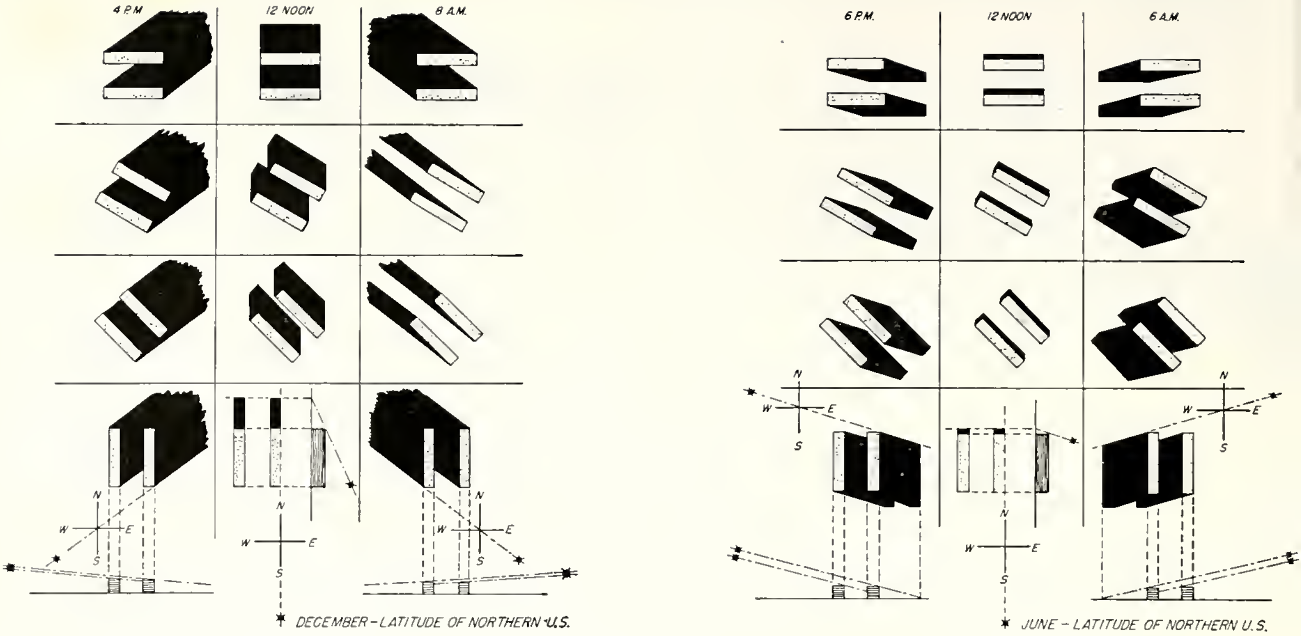


Fig. 164.

be considered; they cut off all possibility of view or outlook and eliminate any possibility of privacy or freedom from noise (Fig. 153). Courts which are narrow in proportion to their length are also bad and should be avoided. To achieve a maximum of privacy and a minimum of noise reflection courts should be wider than they are deep and where possible should have wings placed at an angle to each other (Fig. 156).

Consideration must also be given to placement in relation to noises arising from play areas and from traffic within and outside of the project. Buildings should be placed as far as possible from main traffic arteries. Screens along such arteries of trees or strategically placed low buildings will be helpful (Fig. 158).

There is a definite trend in recent years toward the adoption of more efficient building types and more rational use of land which has received great impetus from the work of the Federal Housing Administration in formulating standards for projects on which they have insured loans. This influence has not been confined to their own projects but has extended in a very large measure to privately financed projects. The work of the Federal Public Housing Authority has also had considerable influence along the same lines. The extensive work and research that has been done in city planning in recent years has also been an important influence and promises to become more so, as progress is made in publicizing this work and in educating the public in regard to the benefits to be obtained from the application of good planning to neighborhood design.

In spite of all the limitations within which the designer must work there still remains a great deal that may be accomplished by proper study and skillful design towards achieving a satisfactory site plan. Most large projects which have been built so far seem to me to fail in the aspect of providing an air of domesticity and livability, presenting instead an institutional air. Instead of human scale, variety, simplicity, and an air of relaxation they present an effect of massiveness, monotony,

and endlessness. It must be remembered that low coverage alone may not produce a good visual effect. Buildings must be properly related to one another and to the natural features of the site (Fig. 159).

The architect in making his plan on paper is too prone to consider the design as a flat pattern. This aspect of the site is of visual importance only to an occasional aviator, and the aspect that really counts from the viewpoint of the tenant is the view out of his window or the effect as the building or group is approached on foot (Fig. 163). Patterns which look well on paper usually disappear entirely when looked at from a low viewpoint and only too often the effect produced on the pedestrian is one of chaos and confusion (Fig. 160). He neither knows nor cares whether or not the street leading to his dwelling is exactly repeated a thousand yards away on the other side of the project.

A valuable design aid in studying this aspect of the problem is the making of a model of the site and the masses of the buildings to be placed thereon. Such a model, even if very crudely made, when viewed from a low viewpoint will be of great assistance in determining how the project will actually appear to the tenant.

Due to all the complex factors affecting building planning and site planning it is not always possible to allow orientation to be the dominant factor in determining the shape of the plan or the relation of buildings to each other, but the effects of sunlight and shadow should always be carefully studied and layouts made having the best possible orientation which a balancing of all factors will permit.

Data on angles of sunlight in easily usable form will be found in the *Don Graf Data Sheets* numbers D-5, a,b,c, and in *Graphic Standards* by Ramsey & Sleeper. Figure 164 shows studies drawn by use of this data. For more extensive study of the problem "Burnett Diagrams"[1] may be used or models may be studied by use of a "Heliodon" or sun machine such as that constructed at Columbia University, and with which it is possible to observe the actual effect of light and shade on the buildings and in the rooms inside of the building.

The orientation of the building and its relation to other buildings is moreover only a part of the problem. The aim of the study of orientation is the correct distribution of light throughout the rooms on the inside of the building. This phase of the problem has two distinct elements: 1. The quantity of light desired in rooms for varing uses and the time of day at which it is preferred; and 2. The means of admitting and controlling light. In regard to the first element, the preferred orientation for living rooms is south or west in order to obtain a maximum of sunlight. Dining spaces should face south or east in order to obtain morning sun, as it is felt that a bright cheery room at breakfast time is a help in starting the day off right. Kitchens should face east or north, some housekeepers like the cheery effect of the morning sun, and some prefer the cooler more even effect of north light.

The preferred location of bedrooms is largely a matter of individual preference. Many people prefer a northern exposure for the bedroom as they do not like to be awakened early by the rising sun as is liable to occur if the room faces east. Bed-

[1] See "The Lighting of Buildings"; Post War Building Studies, No. 12. British Ministry of Public Works. Available from British Information Services, 30 Rockefeller Plaza, New York City—75 cents.

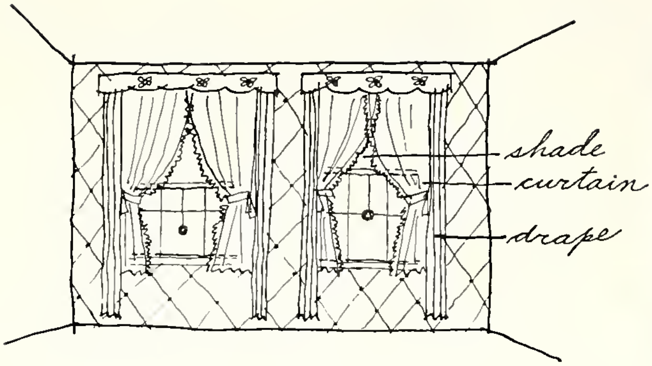


Fig. 165.

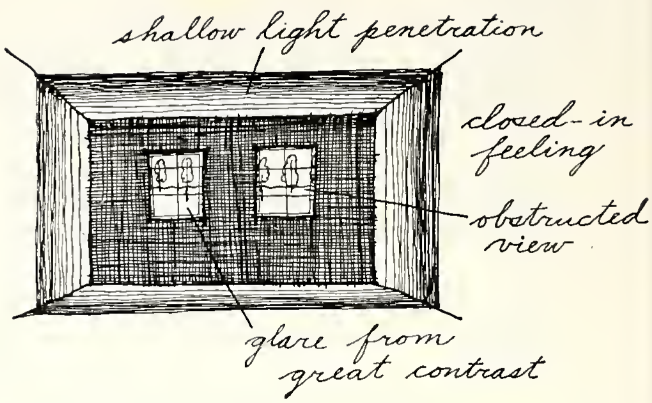


Fig. 166.

rooms which face west are likely to be hot in the evening from the effects of the late afternoon sun.

The second element is of the utmost importance because all of the work involved in careful orientation of the building itself will be nullified if the light is not admitted and properly distributed in the rooms themselves. The windows of a building must perform many and varied functions. They should provide attractive views and a feeling of spaciousness, and stimulate an interest in outside activities as well as affording protection from the elements, a means of ventilation, and a means of admitting light to the rooms.

These considerations may seem to be obvious or trivial, but an examination of many existing buildings will show that such features frequently are neglected to the great detriment of the project. Small windows, widely separated by masonry piers, or small windows located in a far corner of a room, such as are frequently used, do not admit a sufficient quantity of light and do not provide proper distribution of the small amount they do admit (Fig. 166). They also cause a disturbing amount of glare because of the difference in intensity between light windows and dark walls. Rooms which have entire walls of glass do not create effects of glare, although the amount of light admitted is much greater (Fig. 167).

Small isolated windows also obscure views to the outside, especially when they are divided into small panes as is frequently the case. In general, assuming a proper distribution of light, there is no such thing as admitting too much light. No matter how large the windows may be the light indoors will always be of much less intensity than the light outdoors. The need for eliminating glare is emphasized by the fact that a small window is seldom found without its assortment of shades, blinds, and curtains to shut off and soften the light (Fig. 165).

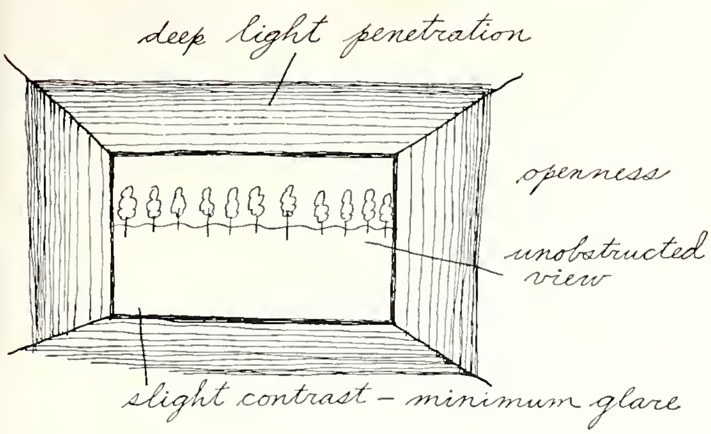


Fig. 167.

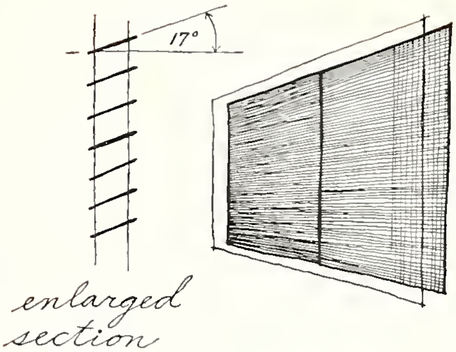


Fig. 168.

Control of light at the window is usually accomplished with shades, awnings, or Venetian blinds. Shades are the least expensive but have the disadvantage of cutting off ventilation. Awnings or Venetian blinds are more expensive to install and maintain, but give better control both of light and air.

The ideal window size from the point of view of maximum admission of light and good distribution would be the full width of the room, with the head of the window near the ceiling and the sill 34 inches or less above the floor. The location of the window head determines the depth of sun penetration into the room, and the continuity of glass from side to side eliminates glare caused by contrast with intermediate piers and dark side walls.

Various methods of control of sunlight are needed for best results on different exposures. During the summer months it is desirable to keep the direct rays of the sun off the glass to avoid excessive heat, and during the winter it is desirable to admit the direct rays to take advantage of its heating effect. Devices have been incorporated into the structure itself, such as movable vanes (Fig. 169) of the type used on some buildings recently built in Brazil, projecting structural hoods (Fig. 170), and strategically placed balconies (Fig. 171). Such devices may also serve as reflectors to diffuse light within the structure. In addition to the shades, curtains, and Venetian blinds previously mentioned use has also been made to a limited extent of metal exterior Venetian blinds. These have the added advantage over the indoor type of keeping the sun off the glass and deflecting rain, so that ventilation may be obtained on rainy days. Special patent type screens have also been used (Fig. 168).

Possibilities inherent in awning type windows with shades attached directly to the sash have up to this time been neglected, probably due to the fact that such windows

are more expensive than double-hung or casement types (Fig. 172). Their use offers many advantages, and possibilities for their use should be explored.

As to the relative costs of large versus small windows, there are again two elements to be considered: 1. Cost of installation, and 2. Effect on heat loss or gain. In regard to the first element, when large openings are used it is not necessary to make all the sash operable. If the same operating sizes are used as when small windows are provided and the balance of the opening made a fixed sheet of glass, the cost of the large window is no more and possibly less than that of the small windows and the section of wall which it replaces. Care should be taken in locating the operable portions of the sash in order that all parts of the fixed surface are within arm's reach so that they may be washed from the inside of the building.

As to the question of heat loss or gain, the amount of operating data available is not sufficient, and the factors affecting fuel consumption are so variable that it is not possible to quote exact results. For the few buildings on which I have been able to obtain information as to fuel costs, the type of system and controls used and the efficiency of the heating layout and installation have been such a large factor that variations in heating cost due to the type or size of windows used have not been apparent. It would not seem, however, that variations in heating cost would have enough effect to be an element in deciding the type or size of windows to be used. In the group of buildings for which data were obtained the cost of heating ranged from a high of about $11.00 per room per year to a low of $7.20 per room per year. The cost of $11.00 was for an 8 story building, with wood double hung sash; another 8 story building with much larger windows of steel sash had a fuel cost of $8.64 per room per year. The lowest cost of $7.20 was for a large 3 story project. The sash used is steel, of the same type as the 8 story building.

Another method of controlling the effect of the sun now being developed is by means of glass itself. Various types have been developed and experimented with, patterned and sandblasted glass for control of glare; green tinted heat absorbing glass for insulation by absorption of direct sun rays; insulating glass consisting of two hermetically sealed pieces of glass with an air space between them; and hollow glass block. Insulating glass is used in lieu of storm sash and is valuable for reducing heat loss in very cold climates and in eliminating condensation on the glass in air conditioned buildings. Glass block is useful for decorative effects and for admitting light to spaces where vision to the outside is not important or desirable. The use of patterned glass in apartment buildings has generally been confined to interior glazed screens and various decorative effects. It has sometimes been used in bathroom windows and in the bottom sashes of very large windows which extend almost to the floor, to obscure vision for the sake of privacy.

Population Density

Requirements for population density in relation to permissible ground coverage and building height will have a great effect on the type of site planning it will be possible to produce on any given project. Standards vary greatly depending on land cost, location, zoning laws, and the jurisdiction of various authorities. It is perhaps significant that the greatest densities are found in buildings for the very rich and the very poor.

Luxury buildings are frequently built at a high density to reduce land cost per unit, due to the expensiveness of land encountered in locations having considerable

"snob" appeal. Very low cost projects frequently are compelled to absorb high land costs due to excessive charges encountered in slum clearance projects, and sometimes even on comparatively inexpensive ground high densities are used in an effort to produce dwelling units at a minimum expense.

Density is usually defined as the number of units per acre of net lot area, not including streets and non-residential areas. The Federal Public Housing Authority considers the following densities satisfactory for low-rent housing: Three story buildings—50 units per acre; Two story apartments—36 units per acre; Duplexes—25 units per acre. It is recommended that lot coverage for the above densities should not exceed 30%. Where density exceeds 50 units per net acre the lot coverage should be decreased. For multi-story buildings densities up to 100 per acre may be used. The Federal Housing Administration usually limits projects for insured loans to a density of 25–40 units per acre depending on the location of the site.

Zoning laws in various sections of the country vary tremendously in their requirements. For example, various counties in Maryland and Virginia in the Metropolitan area of Washington, D.C., vary in their requirements from 625 square feet of lot per family in some counties to as much as 1800 square feet per family in others. So far as height is concerned in these same counties, some locations permit only three stories, some permit six stories, and in some the height is unlimited. Many zoning laws specify only the bulk of building permitted without limiting the number of families that may be accommodated. Some laws of this type permit lot coverages of as high as 90% of the site. This results in extremely overcrowded neighborhoods. Laws which regulate population density rather than mere building bulk go much further toward accomplishing the true ends of zoning regulation and at the same time give the designer freer rein in his attempts to produce a good site or building plan, and most really modern zoning laws are of this type.

A few examples of various types of projects will illustrate the influence of height and ground coverage on densities attained in buildings of various types:

Parkchester, N.Y., 460 square feet of ground per unit, ground coverage 27.4%, height 7 to 13 stories; Red Hook Houses, N.Y., 710 square feet of ground per unit, coverage 17.5%, height 6 stories; Buckingham, Va., 2100 square feet of ground per unit, coverage 17.4%, height mostly 2 stories with a few 3 stories.

As a general rule, on any given project, the architect usually has little to say in regard to population density, but must work in accord with the rules and laws mentioned above, or where they are not the governing elements he is usually bound by economic conditions and the requirements of his client. The architect can at times, however, by demonstrating some of the economic fallacies attendant on excessive overcrowding of land, persuade the client to adopt a more reasonable attitude, and he should constantly exert all the influence at his command toward this end.

Circulation

In locating project entrances their proximity to mass transportation and neighborhood facilities must be considered and they should be located as conveniently as possible. The number of entrances to projects should be kept to a minimum and whenever possible interior streets should be laid out to accommodate local traffic only. Where through streets cannot be avoided buildings should be arranged so as

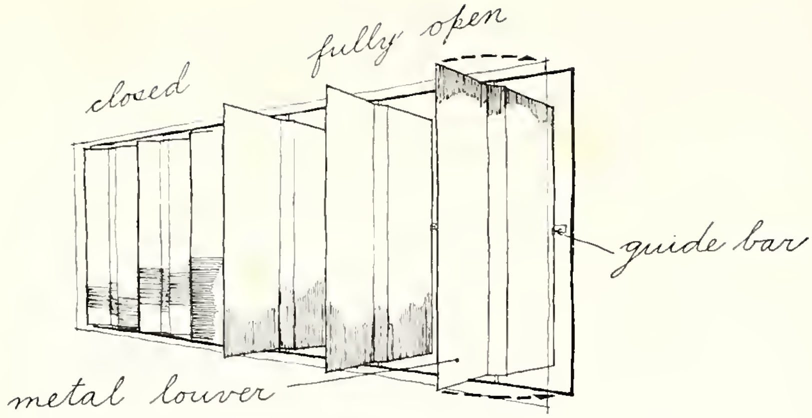


Fig. 169.

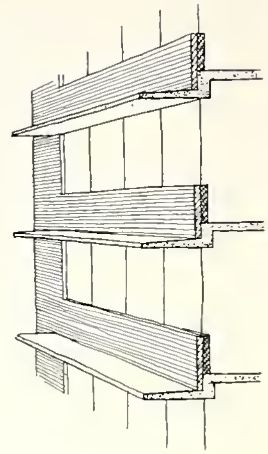


Fig. 170

to have a maximum of protection from traffic noises and fumes. Overpasses or underpasses for pedestrian use should be provided. Angular intersections, especially with heavy traffic streets, are dangerous and should not be used, because the driver of a car entering another street at an acute angle is unable to see approaching traffic (Fig. 173).

Circulation within the project should be so designed as to reduce the speed of traffic and local roads should be as few in number as can adequately service the project. Internal roads should give convenient and fairly close access to building entrances, both for the convenience of the tenants and for service and delivery trucks. Road widths, turnarounds, etc., must be laid out in conformity with local requirements to accommodate fire fighting apparatus, police patrol cars, and to facilitate mail delivery. Provisions must be made for deliveries of fuel, removal of ashes, trash, and garbage. Vehicular access must also be provided at service entrances for moving vans for delivery and removal of furniture and for deliveries to tenants from stores and service industries.

Gridiron street planning should be avoided since it is monotonous and uneconomical, and requires much more street length per building than the super-block layout which is usually used in large projects. Avoid projects made up entirely of angles and curves. Such layouts are visually confusing, it is impossible to devise a proper address system for them, and difficult for visitors and delivery men to find an address in them.

Loop service drives are generally preferable to dead end drives. Dead ends, if used, should not exceed 350 feet in length and should terminate in Y's, T's, or circles for turning. Single lane service drives should be 10 feet wide. Such drives should not be used for main access to building entrances. For loop service drives passing or turning spaces should be provided at intervals not over 300 feet apart and at points of change in direction.

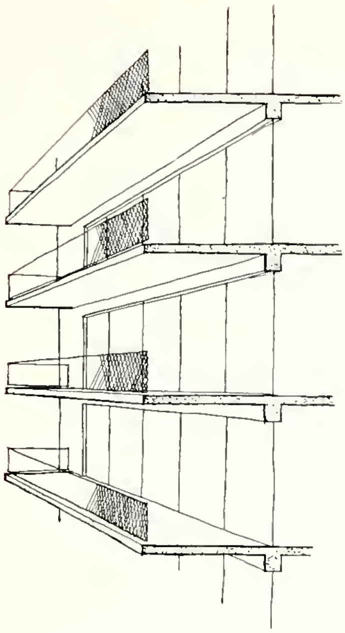


Fig. 171.

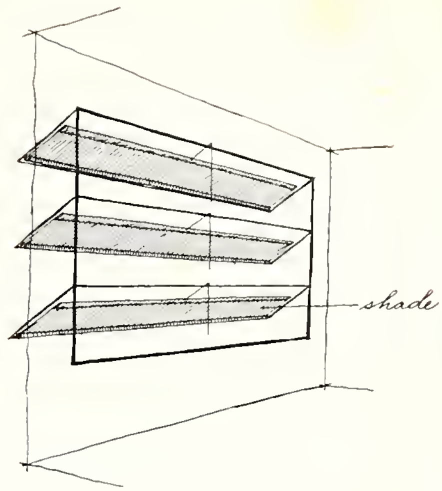


Fig. 172.

Whenever possible, project streets should be dedicated to the city, as this will relieve the project of the expense and difficulties of maintenance. The possibilities of such dedication should be carefully investigated before the planning has proceeded beyond the preliminary stages because most cities have their own requirements for road widths, grades, type of construction, etc., and they will not accept a dedication unless these local standards are complied with.

In the absence of other requirements the following may be used as representing generally accepted standards:

ROADWAY WIDTHS—TWO LANE TRAFFIC

No parking	18 feet
Parallel parking, 1 side	26 feet
Parallel parking, 2 sides	32 feet
Diagonal parking, 1 side	36 feet
Diagonal parking, 2 sides	52 feet
Perpendicular parking, 1 side	40 feet
Perpendicular parking, 2 sides	60 feet

GRADES

	Per cent of slope	
	Maximum	Minimum
Streets and parking spaces	8.00	.50
Sidewalks	10.00	.50
Entrance walks	4.00	1.00
Ramps	15.00	....
Paved play areas	2.00	.50
Paved laundry yards	5.00	.50
Lawns	25.00	1.00
Grass play areas	4.00	.50
Grass banks	3–1 slope	
Planted banks	2–1 slope	

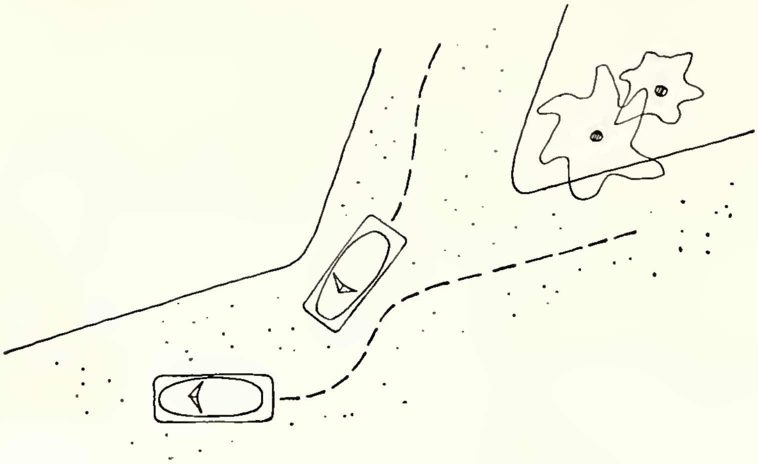


Fig. 173.

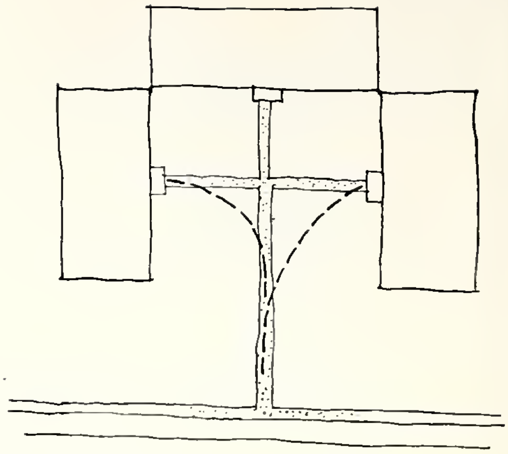


Fig. 174. Inconvenient walks will not be used.

Parking spaces and garages in large projects should have a capacity of at least one car per unit and should be so located as to be accessible to building entrances without a long intervening walk. (See Chapter 7 for further discussion of garages and parking spaces.)

Construction of project roads must be heavy enough for the traffic they will carry, and gutters, catch basins, and storm water lines must be adequate for proper drainage. All principal roads and driveways should be crowned sections with curbs and gutters. Drives with bituminous surfacing and concrete curbs and gutters have given satisfactory service, but where curbs and gutters have been omitted, for reasons of economy, trouble has resulted and maintenance costs have been excessive. Dished sections are recommended for service drives only. Where used they must be of concrete and have a grade of not less than .75%. Walks should preferably be of concrete, and very narrow strips of grass between walks and curbs or buildings should be avoided as they are difficult to maintain. For paved play areas bituminous or cork-asphalt surfacing has given good results.

Neglect of these factors or attempts to save too much money by providing inadequate road and drainage construction will prove costly in the long run. The proper design of these elements is a highly specialized profession and on projects of large size the services of a consulting engineer are well worth while.

Formal layouts of walks and entrance approaches are frequently a source of trouble. The designer must remember that people do not like to be forced to walk in a round-about fashion and the easiest way to lead people to use roads and walks in the manner in which they are intended to be used is to lay them out in a natural sequence conforming to peoples established customs and habits. For example, if a parking space is so located that the tenant after parking his car must walk two

Fig. 175.

blocks to reach the entrance to his building he will not use the space provided, but will park wherever it is most convenient for him. Even hedges and heavy planting will not deter the homeward bound tenant in his search for the shortest path, and much ruined shrubbery bears mute testimony to his trailbreaking proclivities. FHA standards set the maximum length of walk from building entrance to a driveway at 250 feet, but shorter walks are to be preferred.

Walks should be free of steps whenever possible, but when steps are unavoidable they should always consist of at least three risers. Less than three at any one point should never be used. Ramps are preferable as a substitute for steps whenever they can be used at a practicable gradient, and even quite steep, short ramps are frequently desirable as a supplement to steps to aid mothers with baby carriages, children with wagons, etc. (Fig. 175).

In connection with large buildings, main approach walks should be 8 feet wide and minor walks 6 feet wide. For small buildings, principal walks should be 5 feet wide, short approach walks 4 feet wide and minor walks 3 feet wide. Lighting of roads, grounds, and walks should be consistent with local street lighting regulations. Walks and steps should be lighted adequately and placement of lights should be such as not to annoy occupants of the buildings by their rays shining in the windows.

Landscaping

Landscaping contributes a great deal to the aspect of a project and must be carefully laid out to enhance the appearance of the buildings and grounds. Natural features of an interesting character should be preserved whenever possible and should be integrated into the general landscaping scheme. Planting should be designed to enhance the architecture and its massing, texture and colors should receive careful study. The all too frequent method of planting a row of small evergreens around the base of each building of a project is totally inadequate. Groups of trees

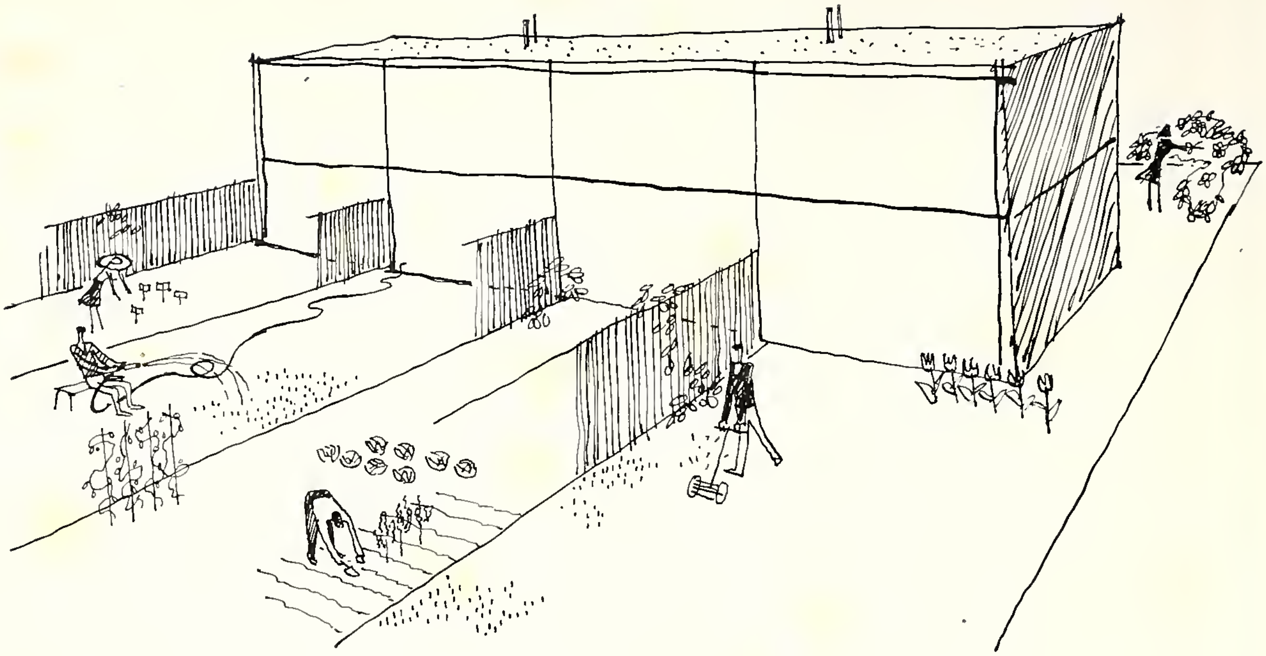


Fig. 176.

or large bushes should be carefully placed to provide interesting vistas and their relations to the buildings should be studied to see that they do not cut off light and air from the apartment windows.

Heavy planting is also useful for screens along heavy traffic ways, around parking compounds and around play areas. It helps here to screen the activities going on and prevents noise from disturbing occupants of the buildings. Landscaping is an essential feature in adding a sense of domesticity and human scale to a project. The cold institutional air of many large housing projects is largely due to a lack of proper planting.

The care of lawns and landscape features is a large maintenance item and its design should be carefully considered from this viewpoint. Careful design of lawn shapes and borders and avoidance of steep slopes makes mowing and trimming easier, and proper selection of other types of planting will eliminate the necessity for considerable work in their maintenance. In general, species of trees and bushes which grow very rapidly are cheaper to install than the slow growing varieties, but the expense of pruning and maintaining them is much greater.

In duplex type apartment projects the grounds immediately adjoining each tenant's unit may be put under the individual tenant's care, thus saving a part of the expense of maintenance on the management's part. This scheme will work in those cases in which the tenants are interested in gardening (Fig. 176), but this is not always the case, and strict rules regarding work to be done by tenants may prove difficult to enforce. A few tenants who leave their yards in an unkempt condition can spoil the appearance of an entire project.

In those projects where space is available it is desirable to set aside an area for

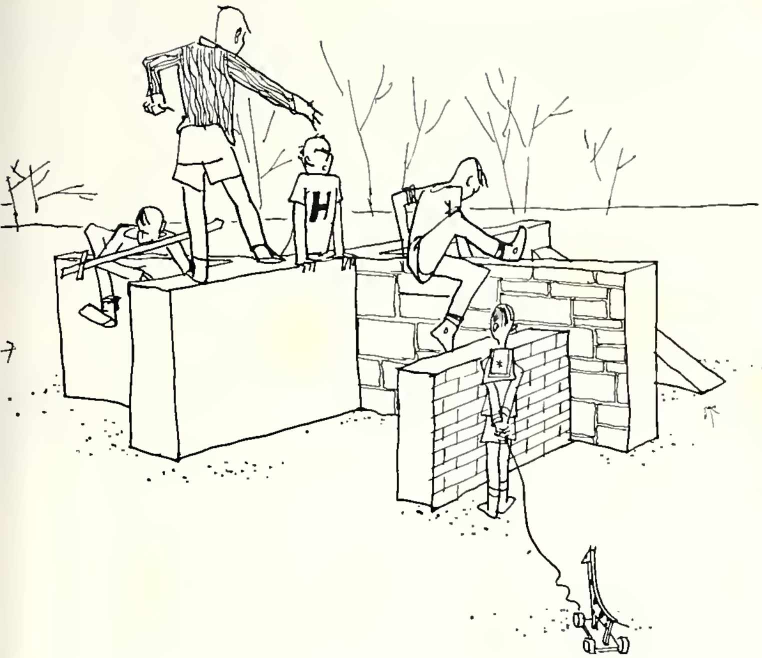


Fig 177

allotment gardens, as some people are very interested in this sort of work and will appreciate the provision of such facilities. These garden areas should be fenced for protection, and sheds for tool storage should be provided. Water should be made available in these areas and the type of ground should be investigated to make sure that it is suitable for the purpose.

Facilities

Provisions should be made where possible for more or less sheltered places where adults may relax or indulge in sun bathing. (See Chapter 7 for a discussion of roof gardens.) All projects should provide small areas for informal recreation, sitting areas for mothers with small children, and small children's play yards. Sitting areas should be equipped with suitable benches or chairs and should be shaded with trees around their perimeter. It has been found by experience that bare unshaded areas are generally avoided. These spaces should provide adequate room for parking baby buggies and a small paved area for children to play on, as well as some space for turf and a space where children may dig. Unless the areas can be well supervised it is best not to furnish sandboxes as they get into an unsanitary condition and accumulate broken glass and other dangerous debris.

Play areas for young children should be located in sheltered areas and should be fenced in for security and supervision. They should be equipped with play apparatus that is of an interesting enough character to cause the children to want to play there. In this connection it has been found that such things as sections of low masonry walls over which they can climb (Fig. 177) and lengths of sewer pipe through which they can crawl (Fig. 178) have proven more attractive than standard playground equipment. Digging holes in the ground also is a pastime that young children enjoy and a place in which this can be indulged should be provided (Fig. 179). Play yards for young children should have about 20% hard surfacing and the balance of their area in turf and digging space. In larger projects additional space may be provided for court games, fixed play equipment, such as swings, slides, climbing bars, etc.

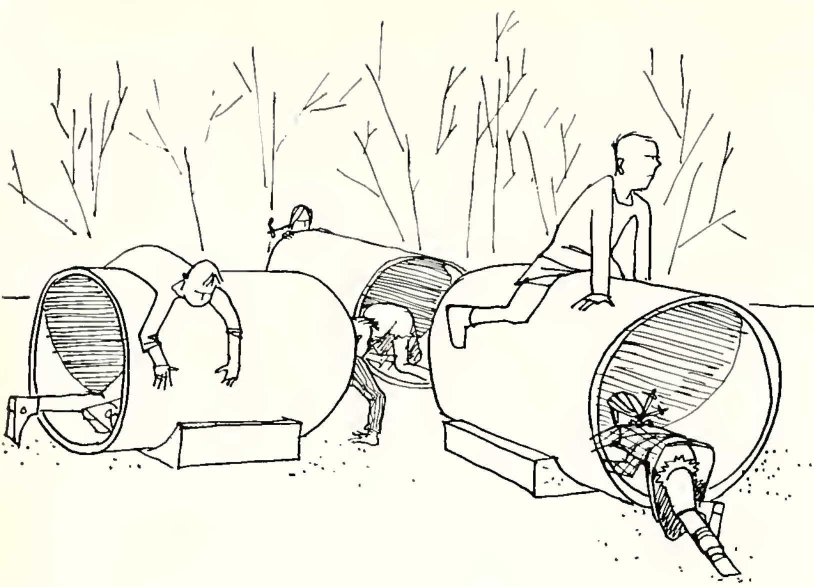


Fig. 178.

Fig. 179.

Large play grounds with supervised facilities for general recreation and areas for baseball, outdoor basketball, and similar games are generally found only in public housing projects as private owners and operators are usually unwilling or unable to provide and supervise such facilities. In a few cases such facilities have been provided in connection with an agreement with public recreation authorities to operate and supervise them.

Community buildings are another feature generally only found in public housing projects. They are usually provided to supplement existing neighborhood facilities and customarily include assembly rooms, club rooms, hobby workshops, and indoor play space for small children. Project managers' offices are frequently located in the community building, as well as maintenance workshops and storage facilities for materials and equipment used in maintenance work.

Where zoning laws permit, the inclusion of retail stores, offices for doctors and dentists, clothing repair and cleaning shops, laundry pick-up stations, beauty parlors, and the like will add to the convenience of living in a large project. Such facilities should form an organized shopping center having its own off-street parking space, as such features scattered indiscriminately among dwelling units are detrimental to the project. The best location for such a center is usually adjacent to a public street on the edge or outside corner of a project and it should be separated from the dwelling portion by a screen of heavy planting.

Other features generally provided, such as laundry drying yards, parking spaces, and facilities for the disposal of trash and garbage are discussed in Chapter 7.

CHAPTER 6: Construction and Specifications

This chapter will be confined to the discussion of those items of construction and specification writing having a direct bearing on the problem of apartment buildings. Data and information usually found in standard handbooks will be omitted. Building is, at present, a highly localized industry and construction practices vary widely in different parts of the country. This is due to variations in the availability of different building materials and to local customs and prejudices. Methods that cost less in one locality may cost more in another due to workmen's unfamiliarity with different techniques and their resistance to change. It is essential, therefore, that the architect thoroughly familiarize himself with the local situation in regard to availability of materials and construction techniques usually employed, as any marked deviation from customary methods is sure to be reflected in excessive building costs.

ypes of Structures

Wall bearing construction is frequently used for buildings up to 4 stories in height, and in some localities even up to 6 stories. Above this height the thickness of bearing walls becomes excessive and skeleton construction is usually more economical. The choice of the type of structure to be used will depend to a large extent on prevailing prices at the time of construction. At the time of writing this book the price of brickwork compared to the price of concrete is so high that many buildings as low as 3 stories in height are being planned for skeleton frame construction. Wall bearing construction should be chosen only where it is adjudged more economical as it has nothing else in its favor.

Skeleton frame construction is almost always more economical for buildings over 3 stories in height and in addition has several other advantages to recommend it. From the standpoint of architectural design it lends itself more readily to the use and placement of large windows, corner windows, balconies, and similar architectural features. It is advantageous from a planning standpoint as it is possible to

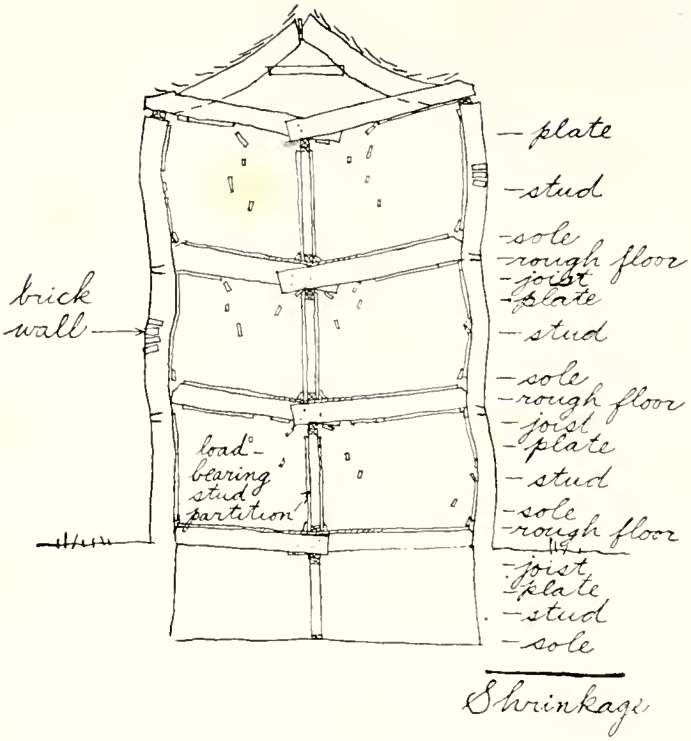


Fig. 180.

use larger spans and more open planning than is practicable when masonry bearing walls and wood floor construction are used. Additional space is gained in the building due to the elimination of heavy interior bearing partitions and fire walls. The use of thinner exterior walls also gains additional space. In actual construction the work is speeded up, because the entire building frame can be erected without waiting for the erection of bearing walls by the mason contractor. Maintenance costs on the completed structure will be lower for skeleton framed buildings due to the elimination of high redecorating costs caused by excessive shrinkage cracks. These cracks will occur in wall bearing buildings with wood floor framing and wood bearing partitions no matter how carefully they may be planned and constructed (Fig. 180). If the building is of completely fire resistive construction maintenance costs will be greatly reduced, and fire insurance premiums will also be much less. At the present time, due to the high price of lumber and millwork and the high cost and scarcity of competent carpenter labor, a very high percentage of even 3 story buildings are being built in Washington, D.C., of completely fire resistive construction.

Another factor of importance in choosing the type of construction to be used is the influence of local building codes and their varying requirements as applied to fire resistive and non-fire resistive structures. These requirements which differ considerably in various parts of the country have a major effect on the plan as exit requirements, height limits, etc., are quite properly much more stringent in the case of non-fire resistive buildings.

A recent study made by architects H. I. Feldman and Andrew Thomas for the American Iron and Steel Institute, the American Institute of Steel Construction, and the Steel Joist Institute, is a good case in point. This study was conducted in regard to buildings erected in the New York area and their conclusions as published in the architectural press showed the following economies inherent in fire resistive

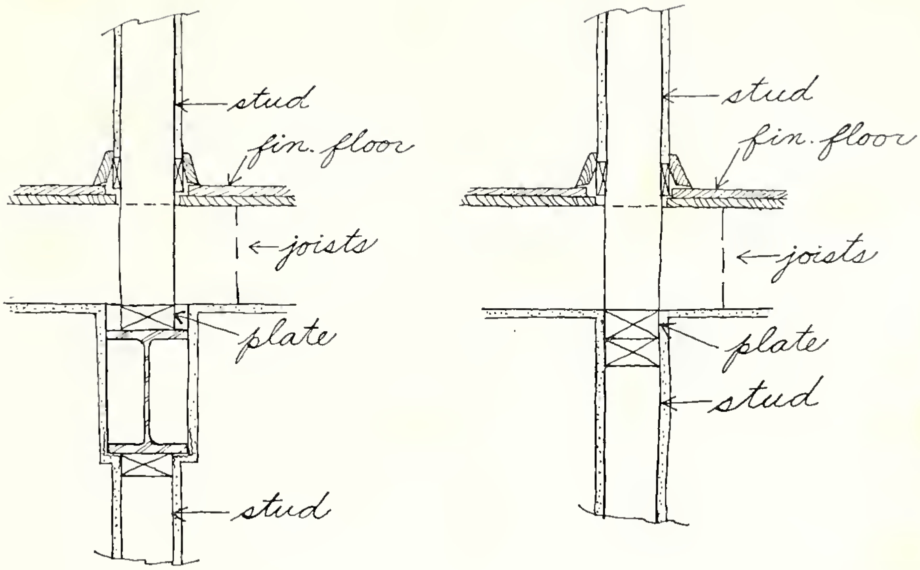


Fig. 181.

construction: 1. Fewer firewall subdivisions; 2. Thinner partitions; 3. Elimination of fire escapes; 4. Use of interior baths and kitchens; 5. Interior location of halls and stairs; 6. Increased space and flexibility of room arrangement.

In the typical plans, which the architects designed in the course of their analysis, 1½ rooms were added to each floor of the fire-resistive building. Architects Feldman and Thomas concluded that: 1. the cost per rentable room for a 6 story fire-resistive apartment building is generally lower than for a non-fire resistive building. In the example designed for study this amount was more than $50 per room or 6.3 percent; 2. The gain in rentable rooms averages 8.6 percent; 3. The addition of these rentable rooms costs on an average 5.1 percent more; 4. An average of 7.1 percent more income is received for the increased space and this increase is sufficient to pay for the increased cost in the first five years of operation.

Types of Floor Construction

If the use of wood joists is decided upon, care must be taken in laying out the floor plans to design spans and bearing partitions within the economical limits of wood construction. Where possible, use should be made of stock lengths of lumber to save the cost of cutting joists and wasting a part of their length. Maximum spans should be held to 18 feet and shorter spans are more economical. Where wood bearing partitions are used partition studs should extend through the floor to the plate below to eliminate the shrinkage which will occur if a platform frame is used (Fig. 181). In a fire-resistive floor construction the choice will generally be based on structural engineering considerations or on local construction practices. In the Washington, D.C., area almost all concrete framed buildings use the joist and tile system, consisting of poured concrete joists with fillers between the joists of clay tile or in some cases of cinder block (Fig. 182).

Stairs

In concrete buildings, concrete stairs, poured along with the rest of the structure, are usually used. Concrete treads should have metal nosings to protect the edges

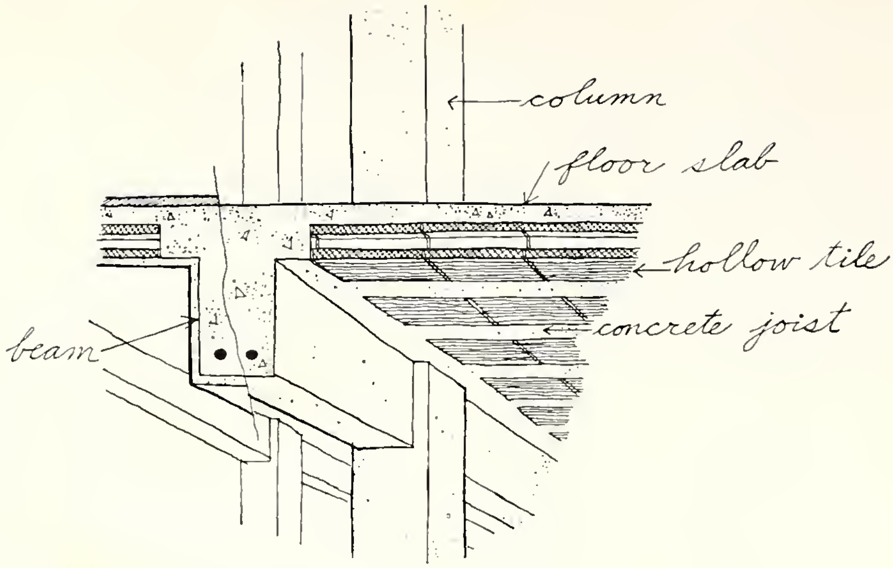


Fig. 182.

against excessive wear. If stairs are to be carpeted wood nailing strips should be inserted in the concrete at the back of the tread. Stair soffits should be poured in plywood or hardboard forms and given a smooth finish so as to eliminate the necessity for plastering them. Where fire resistive stairs are required in buildings with wood or steel joist floors, steel stairs are frequently used. They are usually provided with exposed steel risers. Treads may be cement or slate. Where cement is used it is usually covered with linoleum or asphalt tile.

Rails for service stairs may be mild steel pipe. Welded joints eliminating the use of bulky fittings are recommended. Rails for main stairs may be steel or aluminum, with a wood handrail if desired. They should be simply and sturdily detailed and open spaces should be small enough to make their use safe for small children. Stairs over 3 feet in width should have handrails on both sides. Rails on the partition side may be affixed to the partition with metal brackets.

Interior Partitions

In wood framed buildings partitions may be the conventional wood studs with lath and plaster on each side or solid plaster partitions 2 inches thick with cores of metal lath or gypsum lath may be used. Solid partitions can, of course, only be used for non-bearing partitions. Partitions containing plumbing must be hollow and should be thick enough to insure against any pipe touching the back of the plaster, as this contact is liable to cause stains or cracks to appear on the surface of the partition. Hollow partitions in buildings of fire resistive construction should be built with steel studs with metal lath and plaster facing. Spaces between piping should be filled with a loose fill type of insulating material to deaden sound.

In fire resistive buildings most of the interior partitions are made of gypsum block. Certain partitions around vertical shafts and in contact with the ground are usually required by local building codes to be of clay hollow tile. It is the usual practice

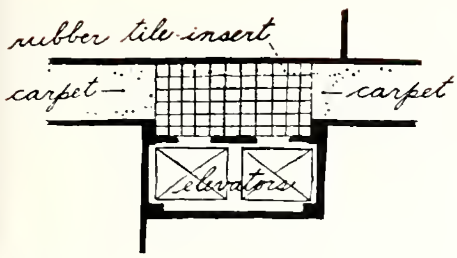


Fig. 183.

Fig. 184. A typical interior. Apartment building at 2420 Wisconsin Avenue, Washington, D. C. Joseph H. Abel, architect. This room has the typical wood block floor and large casement windows. Note the standard casement screens and undersill casement operators. Convector type radiators with metal enclosures are built in under the windows. The furring above the windows is to conceal the supply and return piping for the radiators in the room above.

Rodney McCay Morgan

with gypsum partitions to make the first course of cinder block to facilitate the nailing of grounds and bases.

Many authorities claim that gypsum block is unsuitable for use as a backing for tile in bathrooms, but such partitions have been used to my knowledge for at least 20 years with no signs of any trouble. The portions of the block which are to receive the tile facing should be covered with cement plaster on metal lath. Minor partitions inside of apartment units may also be built of 2 inch solid plaster as discussed above.

In some low-cost projects various dry-wall systems have been tried without very great success. The idea in general has much merit, but needs considerable development before it can be more generally used. The use of a dry-wall system would greatly speed up erection time of buildings, would eliminate the introduction of vast quantities of water, and should give more freedom from unsightly cracks and the danger of falling to which plaster is subject. The advantages of plaster are that it is fire resistant, vermin proof, sanitary, and gives smooth wall surfaces that so far are not obtainable by any other method. Plastered surfaces should have metal corner beads on external corners and on beam edges, and should have cornerites at intersections of walls and partitions with ceilings. Plastered jambs and heads around openings should have bull-nosed metal corner beads, and strips of metal lath placed diagonally at door heads will eliminate many plaster cracks.

Soundproofing

Partitions between apartments may be soundproofed to some extent by furring the partitions on one side and attaching gypsum board plaster base to the furring with special resilient spring clips. Furred ceilings and ceilings of wood framed buildings may be treated in the same manner. This treatment will not cut off all sound completely but will help appreciably, and is, furthermore, the only treatment which is

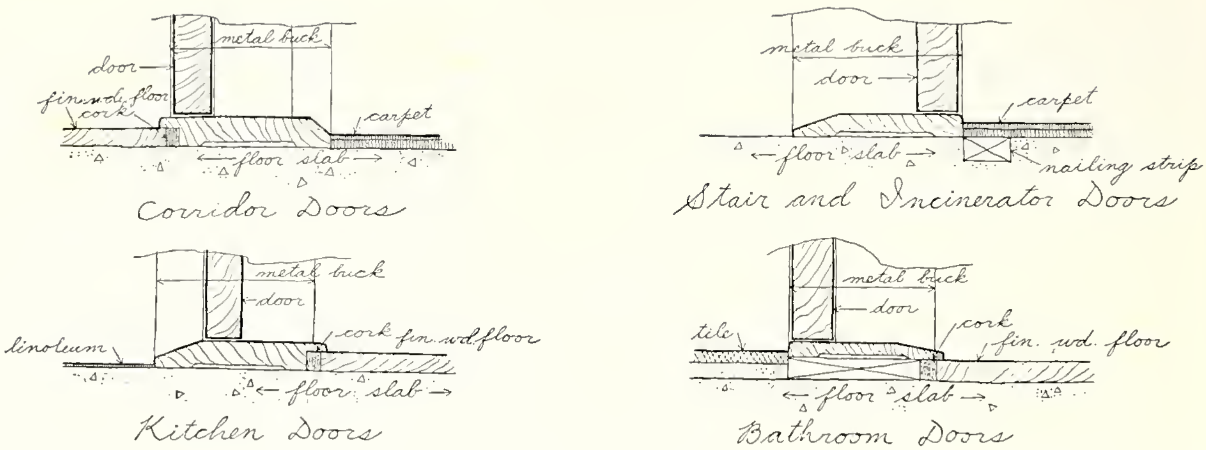


Fig. 185.

economically feasible. Systems of complete soundproofing so far developed are too expensive for use in apartment buildings. Aside from the use of resilient types of finish flooring there is not, to my knowledge, any inexpensive way of soundproofing concrete slab or concrete joist and tile floor systems.

Attention should be given to several items which will help reduce noises. 1. Where medicine cabinets are placed back to back in partitions between adjoining baths insulation should be inserted between them; 2. Loose fill insulation should be placed around piping in hollow partitions; 3. Ventilating fans, elevator machinery, and similar installations should be installed with proper noise reducing mountings.

Floors

Floors in apartment units, aside from bathrooms and kitchens, are usually oak. Strip flooring is usually used in wood framed buildings over diagonally laid subflooring. Pre-finished wood block set in mastic is the usual finish over concrete floors (Fig. 184). When using block floors see that proper cork expansion joints are provided and that the block is not laid too tight. Unless these precautions are taken expansion of the block will pull the floor loose from the slab. The usual flooring in baths is ceramic tile, although occasionally linoleum is used. Corridors and stairs may be surfaced with asphalt tile, linoleum, rubber tile, cork tile, or carpet. Corridors should have the softest flooring that will come within the budget in order to eliminate the noise of footfalls, etc. Carpet is the best for this purpose but is the most expensive to install and maintain. Where carpet is used for corridors it should be broadloom the full width of the corridor. For lobbies and stairs the standard 27 inch width is generally used. If carpet is to be used, it pays to buy a good grade. The best grades, if properly cared for, will last about 8 to 10 years. Wood nailers should be provided in slabs which are to be covered with carpet. Special consideration should be given to spaces directly in front of elevators as this is the point of greatest wear. Inserts of more durable materials are frequently used at this point (Fig. 183).

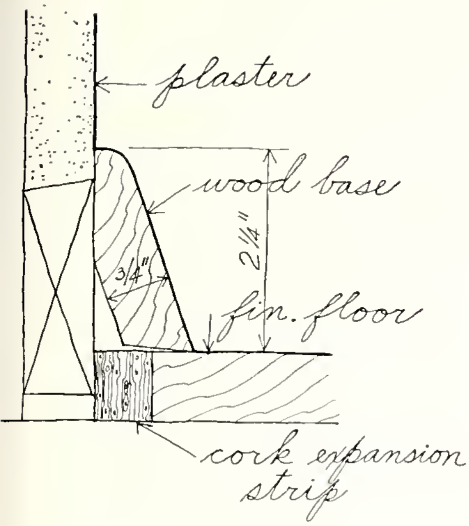


Fig. 186

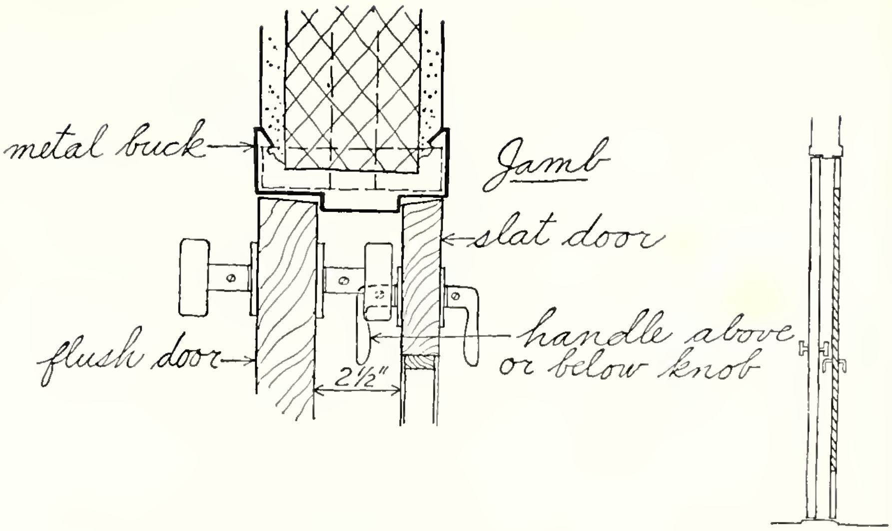


Fig. 187.

Usual construction practice is to make all sub-floors level and to accommodate the varying thicknesses of finish flooring by means of specially designed thresholds (Fig. 185). Where carpeted corridors are used thresholds along the corridor should be wide enough to line up with the outside face of the corridor walls so as to avoid the necessity of running carpet into door reveals.

Interior Trim and Doors

Interior openings should have combination steel bucks and trim. Steel bucks have been found to be advantageous even in wood stud walls, as their use eliminates a considerable amount of carpenter labor. All interior trim and millwork should be of durable quality, be easy to clean and maintain, and be of simple form. Surfaces should be smooth and flat, mouldings and dust catching projections should be eliminated so far as possible. The use of metal door trim flush with plaster walls has been tried but has not been very successful as the joint between the plaster and steel generally results in an unsightly crack. Projecting the trim from ⅛ inch to ¼ inch beyond the surface of the plaster has given good results. Flush metal bases and small one piece wood bases have proved satisfactory (Fig. 186). The old types of two and three piece wood bases are more expensive to install and less satisfactory from the tenants viewpoint as they are more difficult to keep clean and free of dust.

The most serviceable and best looking doors are flush type doors. Egg-crate construction is suitable for interior doors. Construction of apartment entrance doors and stair doors is generally covered by building codes. The usual requirements are Kalamein doors for stairs, and either Kalamein or solid core flush doors for apartment entrances. It is a good idea to provide at least one full length mirror door for each apartment. Mirrors are generally located either in the bathroom or on a bedroom closet door.

Where mechanical ventilation is provided each apartment entrance should be equipped with a wood louvred door in addition to the regular solid door. Louvred

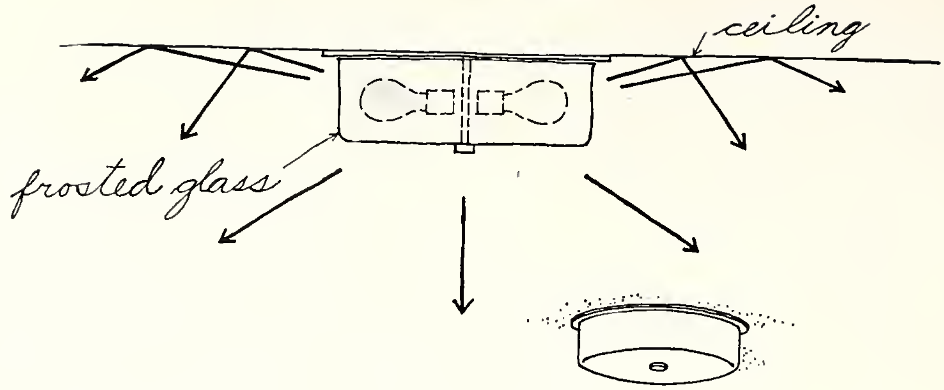


Fig. 188.

doors should have a locking type catch and a hydraulic door check. Care must be taken in detailing the jamb to provide sufficient width of stop for hardware clearance for both doors (Fig. 187). Access doors for plumbing, etc., should be of metal, flush type, with metal lath flanges on the frame. Wooden doors and trim as frequently used for plumbing access are unsightly.

Interior Finish

For plaster walls a painted finish is more satisfactory than wall paper. While the first cost of wall paper is frequently lower than that of paint, the cost of maintenance is much greater. Paint on plaster should be applied over a wall size or primer. With good quality materials two coats should be sufficient, a lead and oil undercoat and a finish coat of lead and oil with eggshell finish. Sprayed work on plaster gives satisfactory results and is frequently used where spraying is not prohibited by Union rules. Casein or resin emulsion paint is frequently used on plaster instead of lead and oil but requires more frequent renewal, and hence is more expensive to maintain. It is disliked by tenants because it cannot be satisfactorily washed.

Interior metal trim, doors, and windows should have two coats over the shop coat or primer with enamel finish. For woodwork, a natural finish is the most durable and shows the least wear and soil. Tops and bottoms of doors should be painted or sealed after fitting to prevent the entrance of moisture. This item is important but is usually neglected.

Fixtures and Fittings

Windows must be equipped with shades or Venetian blinds. If blinds are used care must be taken to select the most durable and rugged type of construction as the repair and servicing of blinds is liable to be a heavy maintenance item. Venetian blinds are usually used in moderate and high rental projects as they have proven to be an attractive rental feature.

The use of good hardware of rugged construction pays from a maintenance view-

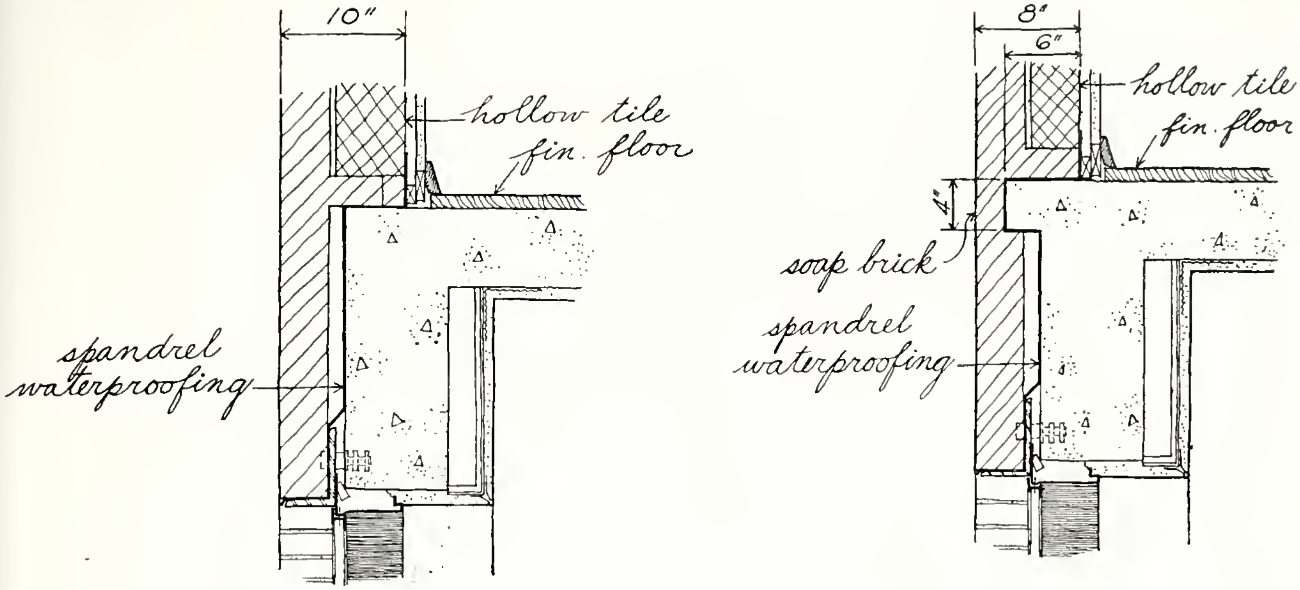


Fig.189.

point. Simple designs, plain surfaces, and durable finishes, such as brushed chrome over nickel on brass are best both from a standpoint of appearance and maintenance. Master key systems should be worked out in conjunction with management as different managers desire various types of systems. Bathroom door locks should be of a type easily opened from the outside. Experience has proven that this precaution will save many forced doors or calls to the fire department to extricate small children and aged people who seem to have a decided proclivity for locking themselves in.

Light fixtures should be of simple design. An enclosing glass ceiling bowl with metal trim is about the best (Fig. 188). Many apartment interiors have been spoiled by the use of gaudy, over-elaborate lighting fixtures of poor design.

Where cast iron plumbing fixtures are used they should have acid-resisting enamel; plain enamel acquires stains and discolorations too quickly. Vitreous china and vitreous-earthenware water-closets and lavatories are preferable. Exposed fittings should be chrome finish.

Exterior Construction

Most apartment building exterior walls are brick faced with a backing of hollow clay tile or cinder block, except in those instances where structural demands require solid brick construction. Ornamental features are frequently introduced which make use of spandrels, trims, and belt courses of stone, metal, stucco, or exposed concrete (Figs. 192, 193, 194). Where climatic conditions are favorable buildings have been built entirely of architectural concrete. The use of architectural concrete for apartments is a subject that deserves more serious consideration than it has been given in the past, as its use may lead to some important economies in construction, especially in conjunction with the use of thin facing panels whose use has recently been permitted under the building codes of some large cities. This subject will be discussed further in Chapter 8.

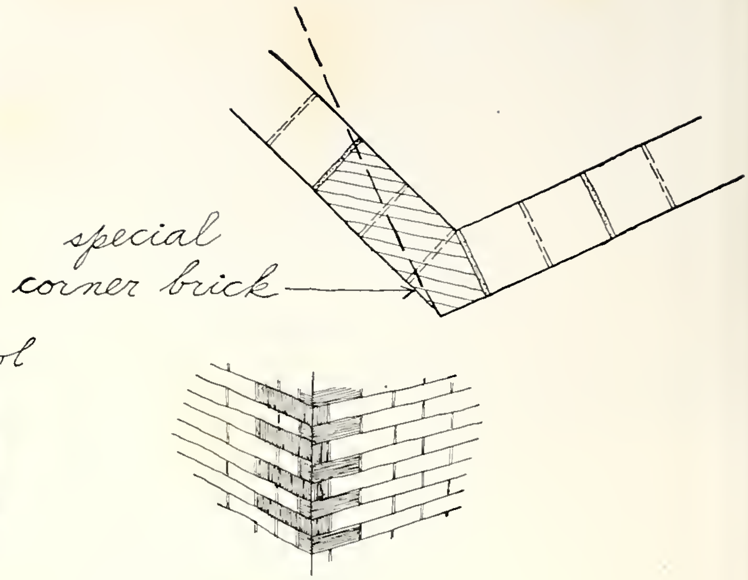


Fig. 191.

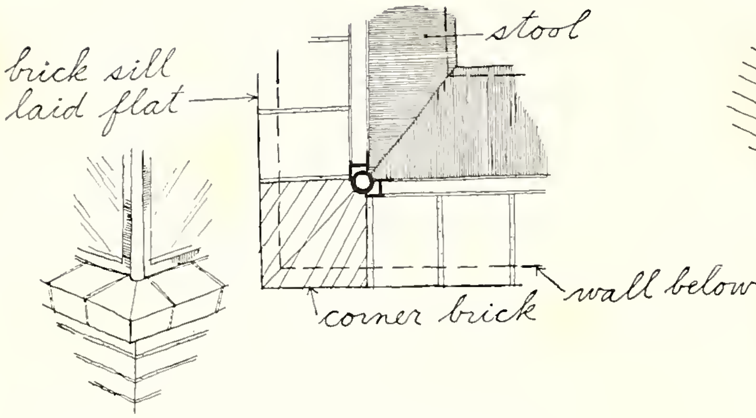


Fig. 190.

In skeleton construction spandrels of various types are used (Fig. 189). the selection of the proper type depending mainly on structural engineering requirements and local building codes. Spandrels should be carefully waterproofed with a membrane type waterproofing carried from the floor over the face of the spandrel and to the outer face of the wall over the window heads.

Aluminum window sills have had some use and have given satisfactory service. Where brick sills are used for corner windows, special one-piece corner bricks should be used (Fig. 190). They are comparatively inexpensive and make a far better job than an attempt to make such a corner with regular brick. Similarly, where exterior walls do not meet at right angles, all external angles should be made with special corner brick (Fig. 191). molded to the correct angle, as use of regular brick is sure to produce an unsightly condition. Specially molded brick should also be used for any curved walls unless the radius of the curve exceeds 10 feet. The use of straight brick on smaller radii will produce unsightly projections (Fig. 196).

Inside surfaces of exterior walls should be sprayed with two coats of emulsified asphalt and should be furred. In some cases walls are plastered directly on the masonry, but this practice is not recommended. Unfurred walls lead to condensation on the interior finished surfaces causing streaking and peeling of paint and damage to plaster. In some cases the bond between the waterproofing and plaster has been entirely destroyed.

High masonry parapets have been a source of frequent trouble and their use should be avoided whenever possible. When their use is necessary they should have through-wall metal flashing, and carefully detailed copings. Both terra cotta and metal copings have given satisfactory service. Terra cotta and copper copings require little maintenance, but galvanized iron requires frequent painting.

Fig. 192. An eight story skeleton framed building. John J. McInerney, owner and builder; Joseph H. Abel, architect. A combination of various materials. Main portion of the walls is of brick. The spandrels between the windows in the central feature are of porcelain enamel. The integral louvres in the central panels are outlets for kitchen exhaust fans. The exposed beams and projecting belt courses above the windows are of concrete with a hand-rubbed finish. The balcony rails are of 8 inch solid brick set directly on the solid concrete balcony slab. Balcony copings are of concrete poured in place.

Fig. 193. A two story 4 family building. J. B. Tiffey & Son, owners and builders; Joseph H. Abel, architect. The red brick is relieved with white stucco spandrels. Roof overhang, porch, and trellis are of wood. Porch posts are steel pipes. The wall behind the stucco spandrels is of frame construction and is supported by the pipe mullions of the corner windows.

Rodney McCay Morgan

Fig. 193A. Parklane Apartments, Houston, Texas. Talbott Wilson and Irwin Morris, architects. Another typical corner window treatment, stuccoed portions of the exterior walls are built of steel studs (see Fig. 194).

Paul Peters

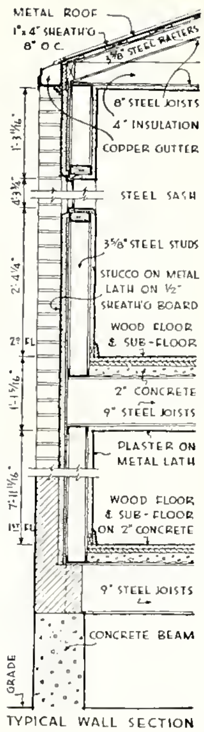
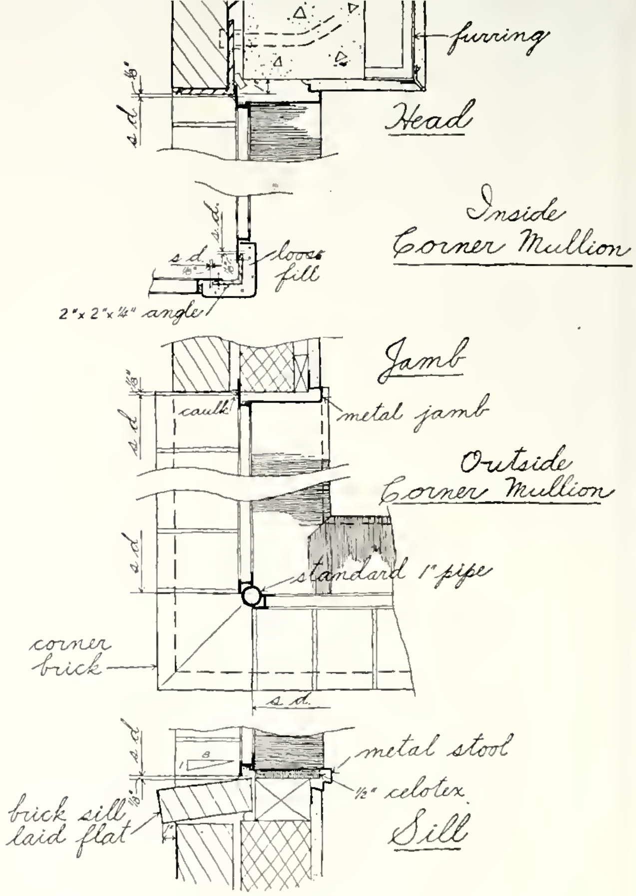


Fig. 194. Parklane Apartments, Houston, Texas.

Fig. 195.



Windows usually are either double hung or casements, projected or other special types have seldom been used. The claim is frequently made that double hung windows are more economical than casements because they are more nearly air-tight and thus conserve fuel during the heating season. Actual figures on heating costs of a number of buildings, some of which have steel sash and some wood double hung windows, do not bear out this theory. Variations in heating costs due to other factors, such as efficiency of the heating system, type of fuel, type of controls, etc., indicate that any difference due to air leakage is negligible, compared to the wide differences caused by these factors. The use of aluminum for windows is recommended, the elimination of painting is a big saving in maintenance cost over a period of years.

Sash divided into small panes with muntins is higher in first cost than large single panes of glass and multiplies housekeeping and maintenance work, as small panes are harder to wash and replacement of putty and painting is more expensive than where large single panes of glass are used. Wood double hung windows have given fairly satisfactory service, but do not give as good an appearance as steel casements, and are liable to stick and be difficult to operate. Steel double hung windows are too expensive to be considered on most apartment buildings. Several types of aluminum double hung windows have appeared on the market and indications are that they will be available shortly at a reasonable price.

Casement windows offer many advantages; they permit full opening for the admission of light and air, they are easy to clean from the inside of the building, the standardization of details and sizes makes for economy, and the application of screens has been worked out in a satisfactory manner. The installation and removal of screens for casements is a simple operation. Figures 195 and 197 show the usual installation conditions. Wood casements are more expensive than steel, offer no

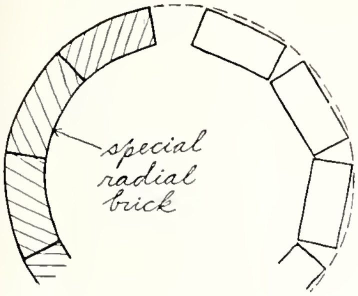


Fig. 196.

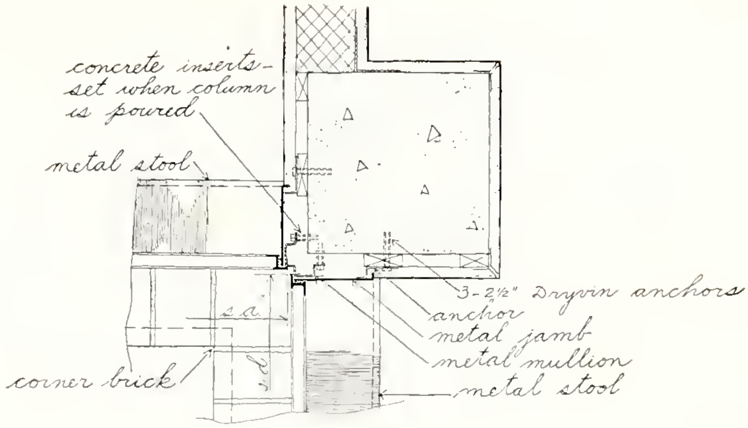


Fig. 197.

particular advantage for apartment buildings, and are seldom used. Attempts to economize on window hardware by use of friction hinges and wicket screens have given very unsatisfactory results. For good service undersill operators are a necessity. The "roto" type, using a crank handle and worm gear operation, is the best. Awning type and sliding windows have been on the market for some time but have not had widespread use. They offer numerous advantages and it is to be hoped that they will be further developed, possibilities for their use are well worth investigating.

The usual glass used in windows is double strength, B grade (DSB). The use of double insulating glass except in extremely large windows probably would not be a paying proposition, except in air conditioned buildings where it would be useful in preventing condensation in the winter months.

Balcony floors are usually formed of solid concrete slabs. They should be sloped to a floor drain. Shallow type drains are used which can be concealed within the slabs. These drains can be connected to a copper tube on the face of the building frame built into the masonry (Fig. 205). Balcony rails may be solid masonry, glass in metal frames, or entirely of metal (Figs. 199, 200, 201, 204). They should be at least 3 feet high and openings should be small enough to give adequate protection to the occupants.

For lobbies, vestibules, etc., standard show window mouldings will be found very useful. Standard steel channels covered with aluminum or bronze make good door frames and transom bars. Large expanses of glass should be glazing quality plate glass. Figure 203 shows details of a number of conditions frequently encountered in apartment building entrances. Figure 202 shows details of several types of marquise construction.

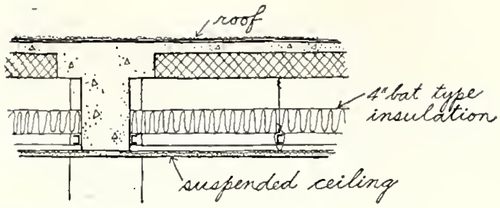


Fig. 198.

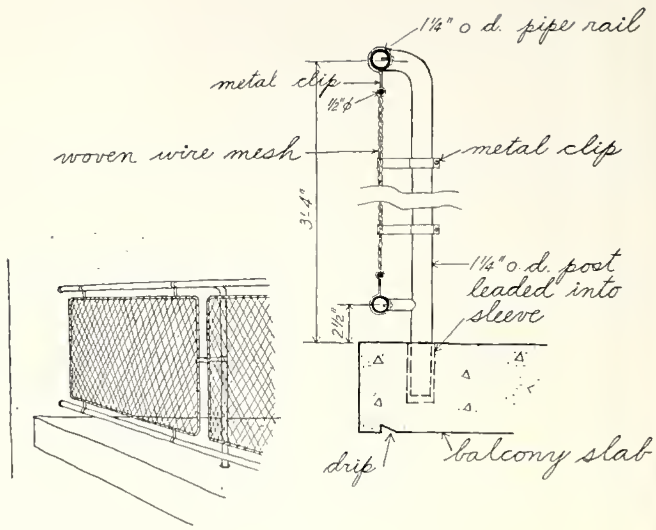


Fig. 199.

Insulation

If a suspended ceiling is used under the roof slab, the ceiling should be insulated with 4 inch bat type insulation (Fig. 198). The space above the insulation must be well ventilated to prevent condensation. In a number of buildings built before the war we have plastered directly on the roof slab, using 1½ inches of rigid board insulation placed above the slab (Fig. 207). Consulting engineers recommend 2 inch insulation for new buildings, it being their opinion that the cost of the additional half-inch will be more than made up by increased fuel savings, and that its use will result in increased comfort for top floor tenants. Insulation board over flat roofs should be thoroughly treated for moisture resistance. Owners report this type of construction to have given perfect satisfaction, there has been less cracking of plaster on the top floor than has occurred with suspended ceilings and no trouble has been experienced with condensation. Plaster cracks in suspended ceilings have been a great source of trouble, and in spite of great care in their design and erection, no way of completely eliminating them has as yet been found.

Ceilings over boiler rooms should be insulated to protect apartments above them from excessive heat. This may be accomplished by the use of 2 inch slab type insulation placed in the bottom of the forms before the concrete is poured or by use of a suspended plaster ceiling over the boiler room with 4 inch batt type insulation above the plaster. If the suspended ceiling is used the space between the ceiling and the floor above must be ventilated to prevent absorption of moisture by the insulation.

Roofs

Over insulation board 4 ply built-up roofing has given satisfactory service. Where roofing is applied directly on the roof slab, 5 ply roofing is recommended. For dead level roofs coal tar pitch is preferred, as being less liable to deterioration from the effects of standing water. Special attention should be given to installation of proper flashing along parapets and around pent houses and other roof structures as leaks are most likely to occur at these points.

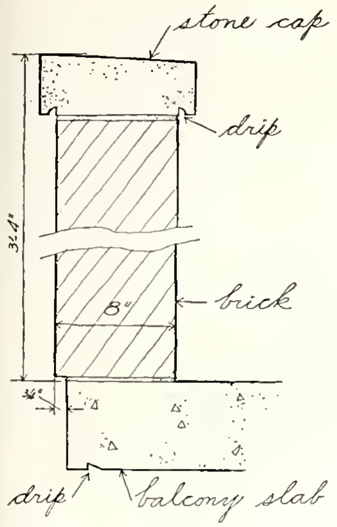


Fig. 200.

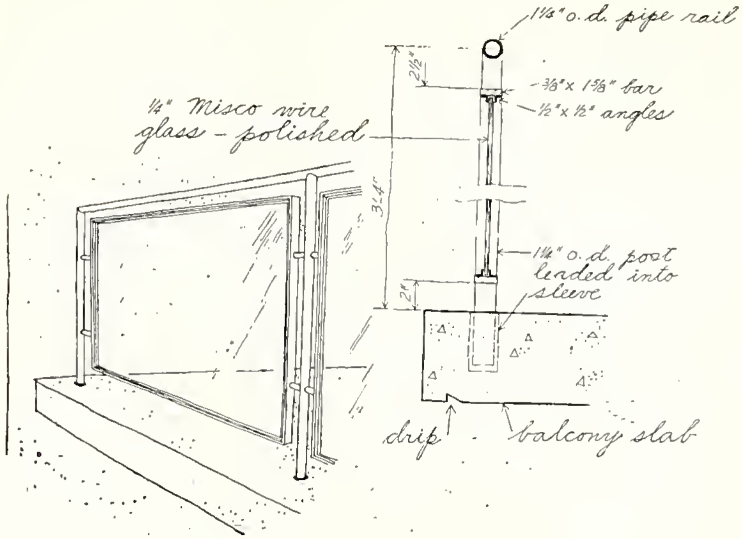


Fig. 201.

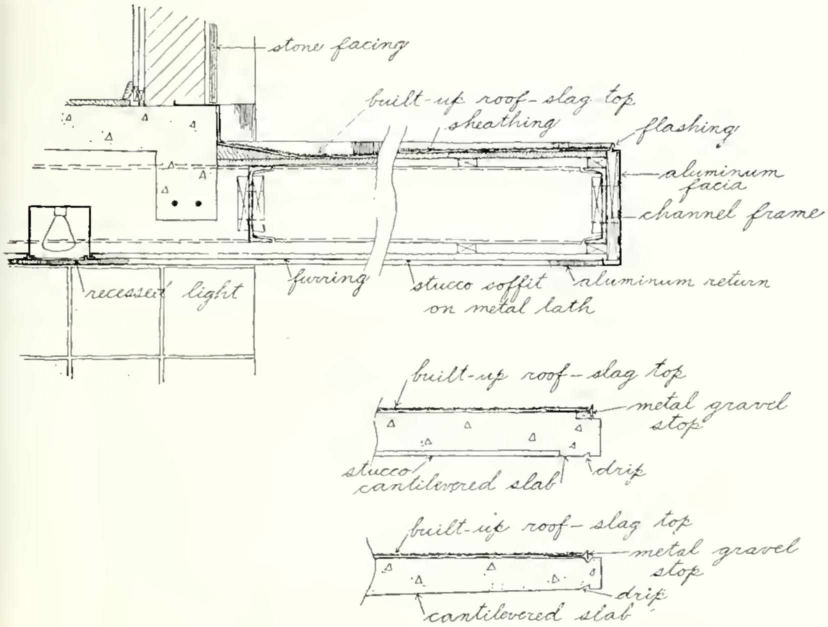


Fig. 202.

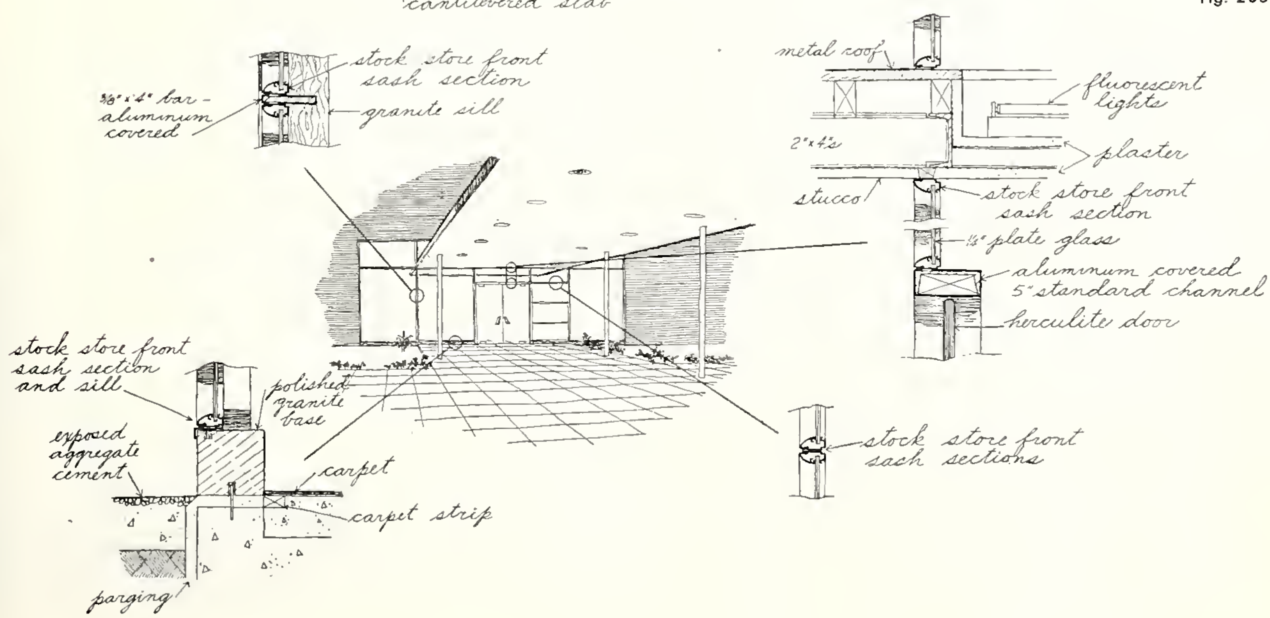


Fig. 203.

Richard Garrison

Fig. 204. Apartment building, 240 Central Park South, New York City. Mayer and Whittlesey, architects. Typical metal balcony rails. Note that while openings have been kept small for protection, a considerable feeling of openness is attained.

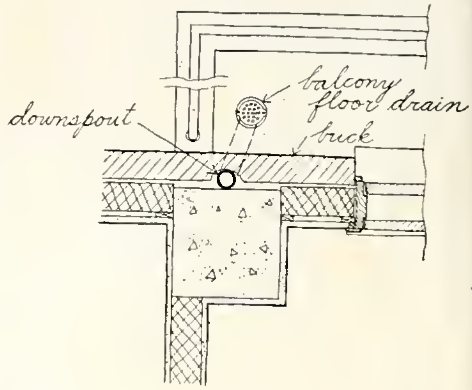


Fig. 205.

Roof decks for tenant use should be surfaced with concrete or tile and should be securely fenced (Figs. 206, 208, 209, 210). Roof decks of wooden duck boards have been tried but have not proved satisfactory due to excessive maintenance. Deck surfaces of special compressed board and similar materials also have been tried but have not been satisfactory as they dent too easily under the weight of furniture. On concrete roof decks care should be taken to provide adequate expansion joints to prevent cracking. Roof decks should be provided with a hose connection to facilitate cleaning and the watering of plants.

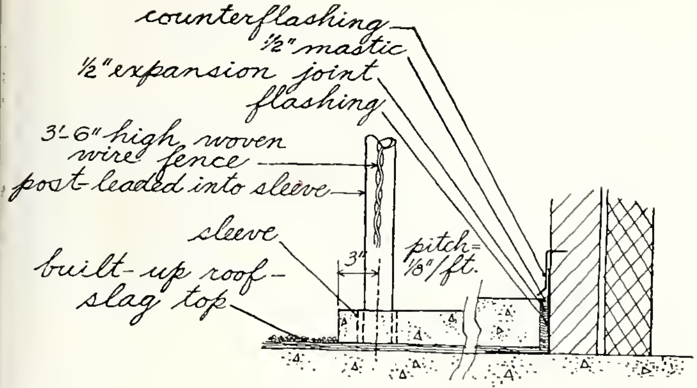
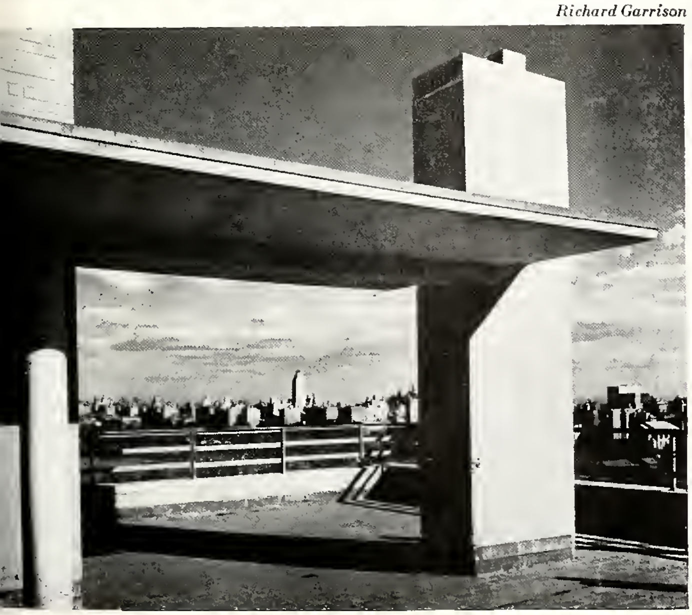


Fig. 206.

Fig. 209. Roof garden on apartment building at 2121 Virginia Avenue, Washington, D. C. John J. McInerney, owner and builder; Joseph H. Abel, architect. The surfacing used here is colored concrete. Note expansion joints. The trellise projecting from the stair penthouse is of wood.

Richard Garrison



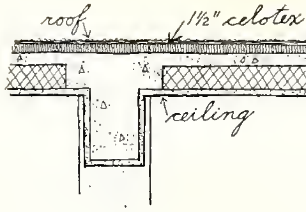


Fig. 207.

Fig. 208. Roof garden on apartment building at 2407 Fifteenth Street, Washington, D. C. John J. McInerney, owner and builder; Joseph H. Abel, architect. The high backed seats and flower boxes conceal roof ventilators. Vent stacks must be carried up 7 feet. Those shown in the illustration are decorated with trellises made of spiral column reinforcing. The type of wooden duck board floor used here quickly rots and requires excessive repair and maintenance work. Light standards as shown just outside the fence are unsightly and unnecessary. Tenants prefer roof gardens to be very dimly lighted, just enough light should be provided to enable people to find the stairs. The chain link fence as shown gives good protection with a fair amount of visibility.

Thomas Scott

Fig. 210 (lower left). Roof garden on apartment building at 240 Central Park South, New York City. Mayer and Whittlesey, architects. Surfacing of tile. The parapet is a combination of brick and open metal work. The cantilevered concrete hood, supported by masonry chimneys, adds a decorative feature and unifies the composition

CHAPTER 7: Facilities

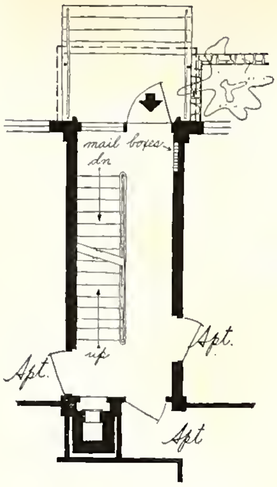


Fig. 211.

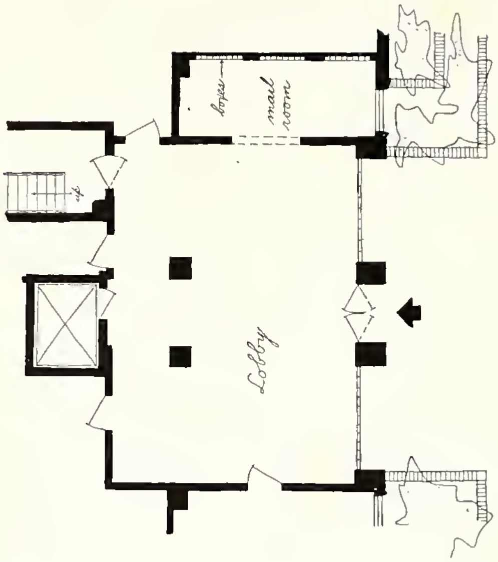


Fig. 212.

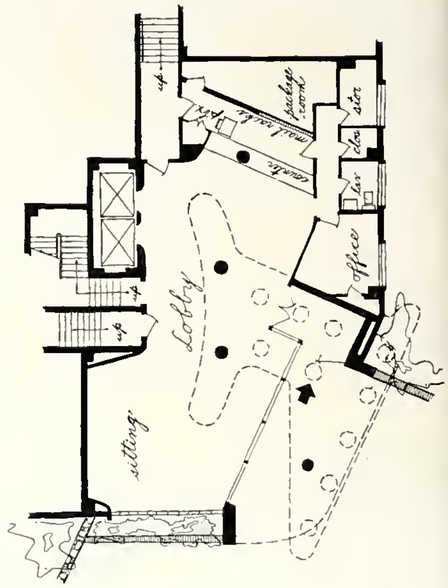


Fig. 213.

Public Spaces

Lobbies should be made as small as possible consistent with the functions they are to serve. In low-rent buildings, the lobby's function is to serve as an entrance to the building and sometimes as a location for mail delivery and distribution (Fig. 211). Mail boxes must conform to Post Office regulations and should be mounted flush in a partition. There should also be a shelf provided to hold magazines and parcels too large to be put into the individual boxes. Where the number of boxes used in any one lobby is large they should be located in an alcove out of the direct line of circulation through the lobby (Fig. 212).

Materials and finishes in lobbies should be as simple as possible and of the most durable and easily maintained type that can be afforded because the lobby is subject to considerable wear and tear and maintenance of cheap finishes is difficult and expensive (Figs. 214, 215, 216, 217). The proper maintenance of lobbies, stair halls, and corridors should not be neglected, because, if they are left in a shabby condition, as is frequently the case, they have a depressing effect on the general tone and morale of the entire building.

Lobbies in buildings of moderate and higher rental brackets frequently require added space for additional services, such as counters for clerks, mail racks, telephone switchboards, manager's offices, package storage rooms, and seating space for visitors (Fig. 213), depending on the type of occupancy and services to be rendered tenants. Where the lobby is designed for use by clerks and switchboard operators working at an open counter, a vestibule with double doors is a necessity (Fig. 218). Lack of such a vestibule has been a source of constant complaint in many buildings, and such complaints have frequently caused the erection of storm doors or vestibules, which, being added as an afterthought, usually are unsightly and spoil the effect which the architect intended for the main entrance. If such features are incorporated in the original plan they can be properly integrated with the building.

Fig. 214 (above). Lobby in apartment building at 2407 Fifteenth Street. John J. McInerney, owner and builder; Joseph H. Abel, architect. Rear wall and portion of ceiling is of wood veneer fastened to canvas and glued to wall. This material, while capable of interesting and varied decorative effects, is not durable. It invariably blisters and peels off the wall. Its use is not recommended where durability or permanence is a factor. The small alcove, at the right of the picture, provides a space for mail boxes out of the main line of circulation through the lobby (see plan, Fig. 212). The main portion of the floor is carpeted. The floor of the mail alcove is of marble.

Horydczak

Fig. 215 (above, right). Lobby in apartment building at 2121 Virginia Avenue, Washington, D. C. John J. McInerney, owner and builder; Joseph H. Abel, architect. Floor of black terrazzo, with carpet rug in central portion. The column coverings are extruded aluminum, the circular thingumabobs at the tops of the columns are light fixtures. The elevator doors and jambs and the small space between the door jambs are of aluminum. The counters are of plywood with black marble tops (see floor plan, Fig. 224).

Fig. 216 (below). Lobby in the Croydon Apartment. John J. McInerney, owner and builder; Joseph H. Abel, architect. Curved front wall of glass block, with tempered glass doors in steel channel frame covered with bronze. The counter front is covered with wall rubber, counter top is black marble. Planting box, at the right, is of face brick, of the same color as is used on the exterior of the building. Ceiling is of painted plaster. The floor is terrazzo.

Rodney McCay Morgan

Fig. 217 (below, right). Lobby in the Washington House, 16th Street at Florida Avenue, Washington, D. C. Mark Winkler, owner; Alvin Aubinoe, builder; Eugene Schoen, decorator; Joseph H. Abel, architect. The open front and mirrored side wall make this small lobby seem more spacious than it really is. The walls are covered with leather which has not worn well and will have to be removed. The over-all carpet is badly worn along the line of main circulation from the front door to the counter and to the elevators. A terrazzo or marble floor covered partially with rugs would have been better, as the worn portions could have been replaced without having to recover the entire floor, as will now have to be done. The anemostat in the center of the ceiling distributes dust over the adjacent portion of the ceiling causing a need for frequent repainting. A washable material placed around it would help to correct this condition.

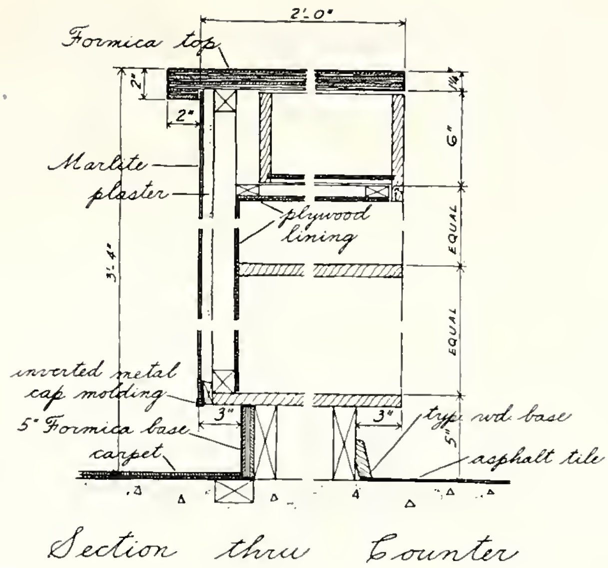


Fig. 219.

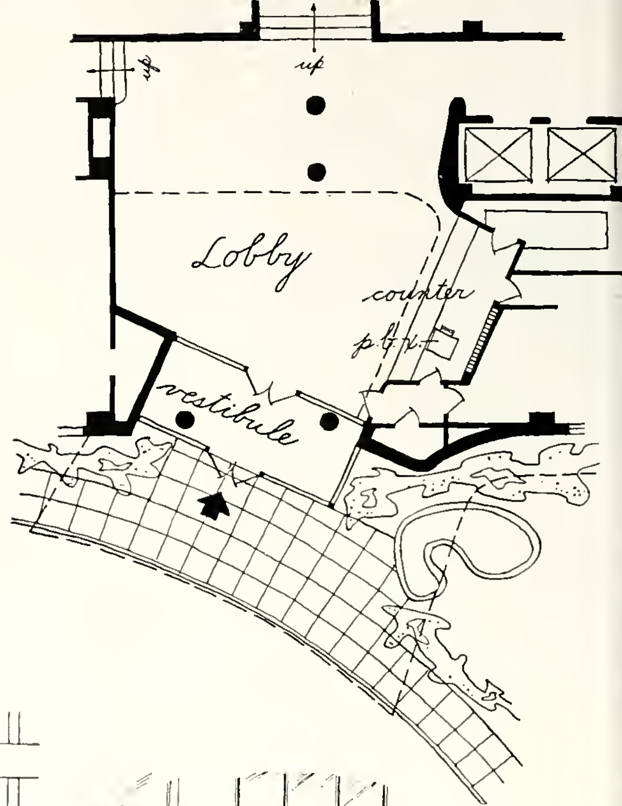


Fig. 218

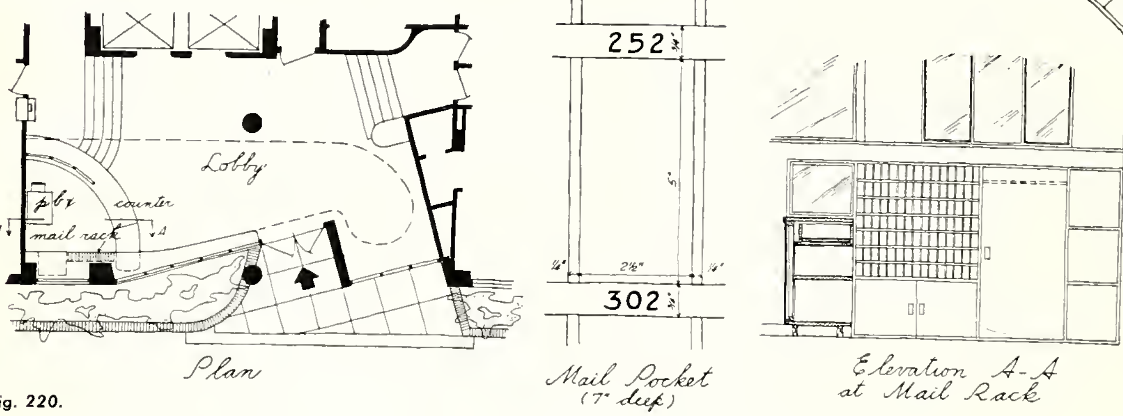


Fig. 220.

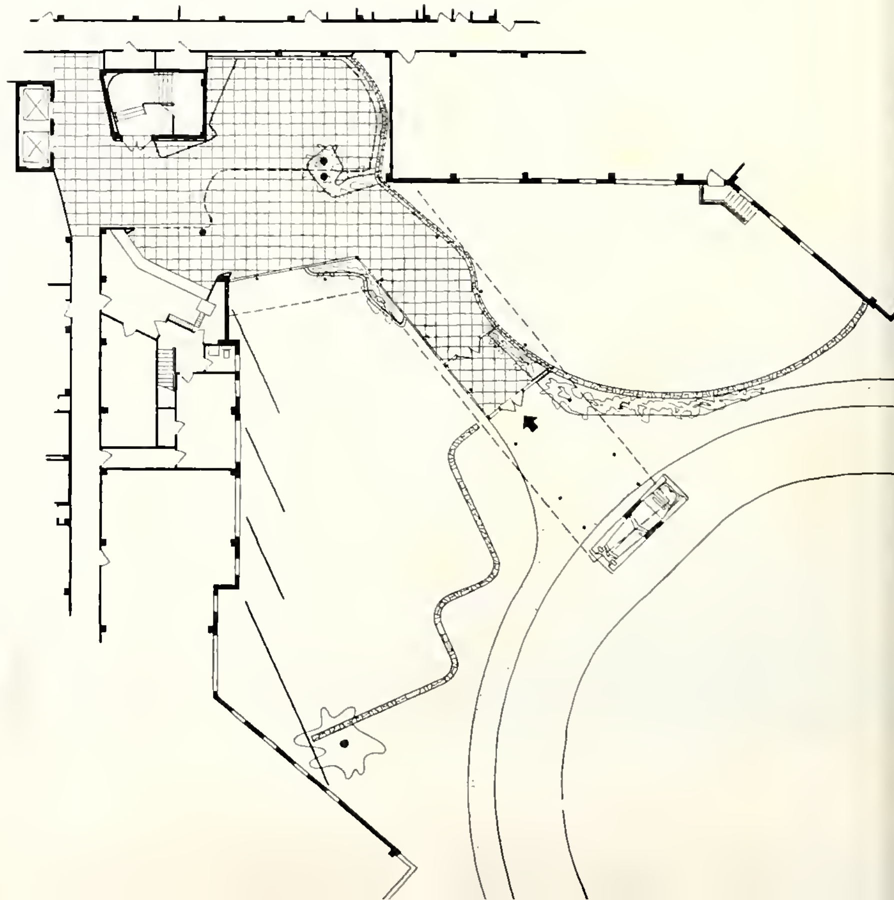


Fig. 221.

Fig. 222.

design. If the requirements of the plan are such that the lobby is located in a deep court and is served by a driveway for automobiles, then the vestibule or a similar covered passage should extend out from the lobby for a sufficient distance to keep the driveway far enough away from the building that the tenants will not be disturbed by the noise and fumes from the cars. Figure 221 shows the plan of such an extended approach. Note that the driveway is kept almost at the outer face of the building, and that the apartments on the lower floors are given the added protection of a masonry wall. Figure 222 is a perspective study of the same entrance. The walls of the approach corridor have been shown mostly of glass in order to avoid the effect of a narrow corridor and to admit as much light as possible into the lobby. Figure 223 is a study of the interior of the lobby.

Counter tops receive considerable wear and must be made of durable materials, such as plywood, marble, glass, or plastic (Fig. 219). Faces of counters should also be of durable materials and a recessed toe space should be provided.

In small buildings, where one operator tends the switchboard and also distributes mail, the mail rack should be located within easy reach of the switchboard (Fig. 220), and should also be visible to the tenants as they stand at the counter. Switchboard service may be of two different types, a PBX in which all calls go through the switchboard or a secretarial service in which each tenant has his own phone line which may be shifted by means of a switch in the apartment unit to the secretarial board, so that calls or messages may be received for the tenant by the operator in his absence. Choice of the type of system to be used will depend on local customs and the form of service to be rendered.

Space required for managers and clerical staff will depend on the size of the building and the type of management. Some buildings handle all business from a central

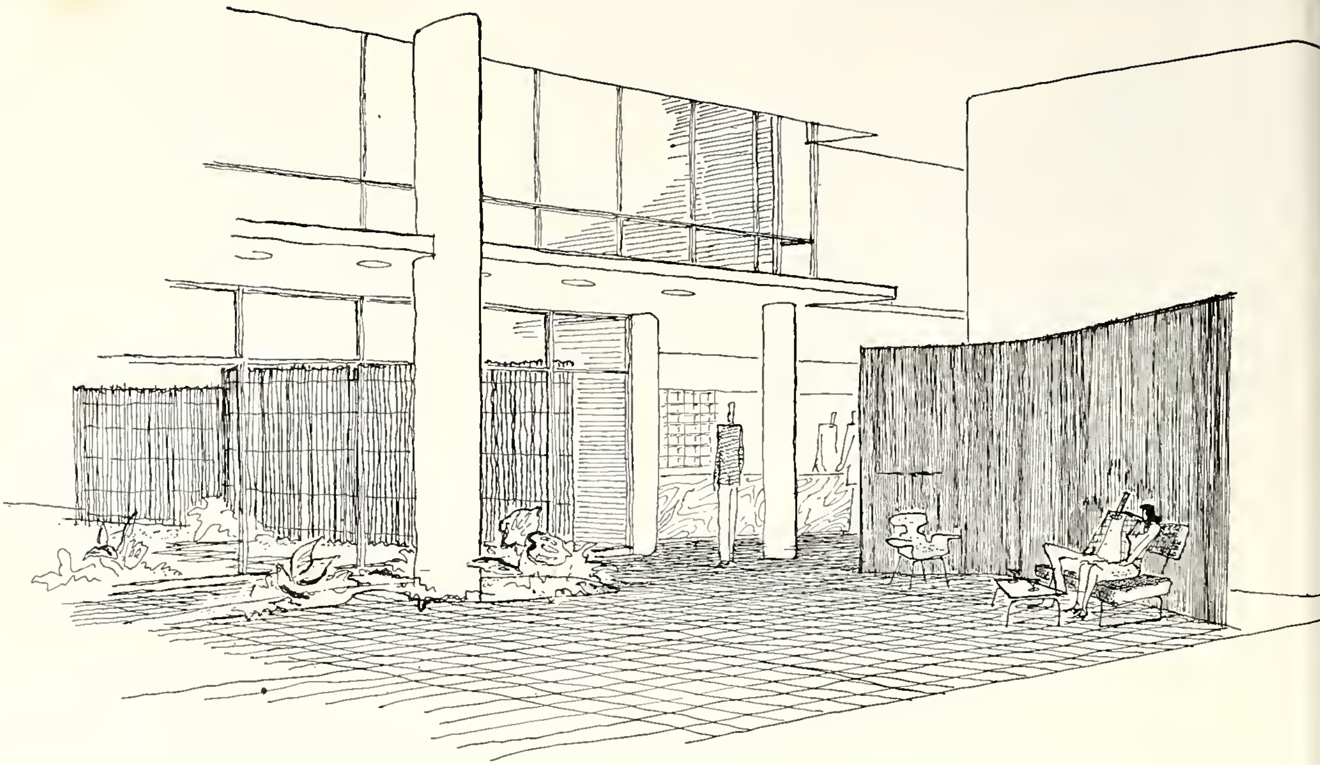


Fig. 223.

real estate or management office and require little or no space on the premises. Some have a resident manager who handles conferences with tenants, reviews leases, and does other minor business on the premises, with other clerical work, bookkeeping, etc., being handled by a central office. Still others do all work on the premises. Management policy should be determined in advance and adequate office space provided.

Space for the reception of deliveries for tenants, where required, should be adjacent to the switchboard and counter, or to the station of the person appointed to receive such articles. If located adjacent to the lobby it should be connected to the service entrance in such a way that deliveries can be made without the necessity for delivery boys entering the lobby (Fig. 224).

Elaborate lounges, promenades, and similar spaces are in general a waste of space and money. In the great majority of apartment buildings they are entirely unnecessary, and in most buildings in which they have been provided they have not been used by the tenants to any extent. Game rooms for use by tenants have been provided in some buildings and have been used successfully. They provide facilities for ping pong, billiards, and similar activities. Party rooms which provide space for tenants' parties (for groups too large to be entertained in their own apartments) have also been tried (Fig. 225), but building managers report that such rooms have been overly abused and are a cause of undue maintenance expense. Small basement spaces may be assigned to tenants for use as hobby rooms and for work that cannot conveniently be done in the apartments. Such areas are usually fitted out by the tenants themselves, and can be used as carpenter shops and photographic darkrooms.

When zoning laws permit, restaurants are frequently located on the main floors of apartment buildings and have been frequently found to be an attractive feature as

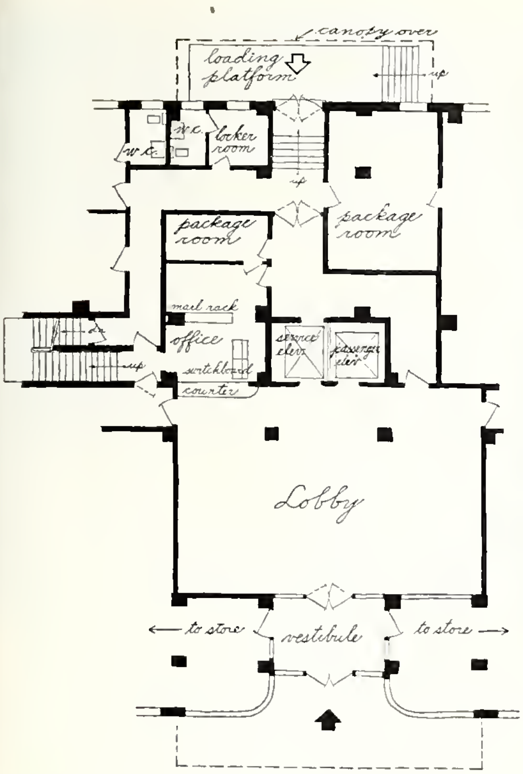


Fig. 224.

Thomas Scott

Fig. 225. Party room in apartment building at 2929 Connecticut Avenue. Henry K. Jowish and Paul Townsend, owners and builders; Joseph H. Abel, architect. Wood block floors; walls covered with wall rubber; ceiling painted plaster. Folding doors permit the two rooms to be used either separately or together, to accommodate parties of varying sizes. Built-in bars are provided, but tenants must furnish their own liquor. Tenants were allowed to use these rooms on payment of a nominal fee, just sufficient to pay for the expense of cleaning and maintenance.

well as a good source of additional revenue. Care should be taken in assigning space for a restaurant. There must be an area for customers waiting for tables. This should be away from main lines of circulation through the lobby. Barber shops, beauty shops, and small retail stores may often be located advantageously in apartment buildings. Their location in large projects has been discussed under site planning (see Chapter 5). When incorporated into a single apartment building they should be located so as not to detract from the residential atmosphere of the building (Figs. 226, 227). Use of signs and displays should be strictly controlled by suitable provisions incorporated in the leases of any commercial establishments, and care should be taken that these provisions are firmly adhered to.

Laundry and Drying Facilities

Laundry rooms should be of adequate size and well ventilated and lighted. About 500 square feet will serve about 100 apartments and should be increased proportionately for larger buildings. Laundries and drying spaces should be so located as to require a minimum of travel on the part of the housewife. In many existing projects of the "garden type," laundries have been located at widely separated points requiring a lengthy haul from many of the apartments. In 2 and 3 story buildings it would prove better to have a number of small laundries conveniently located, instead of the more usual practice of locating such rooms several hundred feet apart. In multi-story buildings laundries may be located in the basement, or on the roof of every building, thus requiring no horizontal travel through the grounds.

Laundry rooms should be equipped with wash tubs and washing machines. Where machines are installed, one two-part tray per hundred apartments is sufficient. Washing machines are usually of the coin operated type. The machines usually used are of the same type as those manufactured for ordinary household use and are not of rugged enough construction to stand the abuse they get at the hands of tenants and so require frequent maintenance and repair. Toilet facilities for maids should be provided, and are usually located in or adjacent to the laundry room.

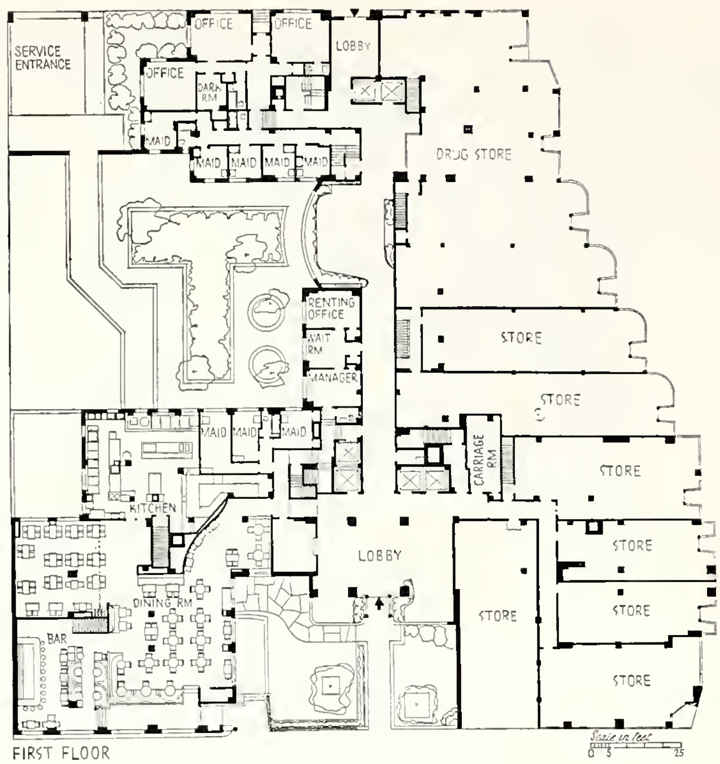


Fig. 227.

Fig. 226. The first floor plan of the apartment building at 240 Central Park South, New York City. Mayer and Whittlesey, architects. This layout illustrates many of the points discussed in relation to urban apartment buildings located in commercial neighborhoods. The lobby is well segregated from the commercial portion of the building and the main entrance to the restaurant is from the street, although a small entrance is provided off the lobby for the convenience of tenants of the building. While this project is really composed of two separate buildings the first floors of both are tied together. Notice that lobbies are provided on two streets and are joined by a public corridor. Sitting space is provided near the center of this corridor with a pleasant view over a little garden. Maids' rooms have been provided, separated from the public spaces by a small hall, and ample facilities have been allotted. Fig. 227. The service entry, upper right, is well separated from the balance of the building and has a canopy for protection. Below, left, is a small sitting space near the main entrance; at right, sitting space near the center of the corridor with a view down the corridor to the main entrance. Simple, plain surfaces have been used throughout. Terrazzo floors, marble and terra cotta wall surfaces, metal column coverings, and simple lighting fixtures. The use of interior planting as a decorative feature has been successful. The landscape design is by Eleanor Robertson Paepcke and Cynthia Wiley, landscape architects.

Mattie Edwards Hewitt

Richard Garrison

Fig. 227-A. Left, view towards main entrance. Right, bar and restaurant.

In localities which limit the height of buildings, laundries are usually located in the basement. Where heights are not limited it is sometimes advantageous to locate laundries on the roof, adjacent to protected play spaces for small children.

In addition to the laundry room itself adequate space for clothes drying must be provided. Where there is sufficient room a sheltered space out of doors where clothes can receive the benefits of sunshine and air is desirable. Space assigned for laundry drying yards should have paved aisles between groups of lines and a paved walk leading to indoor laundry facilities. Space should be assigned as near to the indoor facilities as possible giving due consideration to matters of appearance and exposure to sun and breeze. For grouped facilities 15 feet of line per apartment is usually sufficient. Placement in relation to chimneys should be chosen to avoid soot falling or blowing over clothes. Wire lines should be used in outdoor spaces supported on strong pipe standards. Drying yards should be enclosed with high fences for protection.

This outdoor space should be supplemented by indoors space for use in inclement weather. Space indoors, unless equipped with gas or electric heated clothes dryers, should be about twice as big as the laundry room itself. It is usually best practice for the management to furnish lines for drying rather than to allow tenants to put up their own lines. Lines should be of non-corrosive twisted wire, spaced about 18 inches apart with aisles 3 feet wide between groups of not more than four lines. The maximum span for wire lines is 35 feet, and hooks should be 6 feet 6 inches high.

Employees' Facilities

Facilities required for employees will vary with the type of building. In most apartments, janitors' living quarters are provided in the basement, opening into the service corridor (Fig. 229). In buildings employing hall boys, elevator operators, etc., toilet rooms should be provided for their use in conjunction with a small dressing room equipped with steel clothes lockers. (See first section for facilities needed in connection with public spaces.)

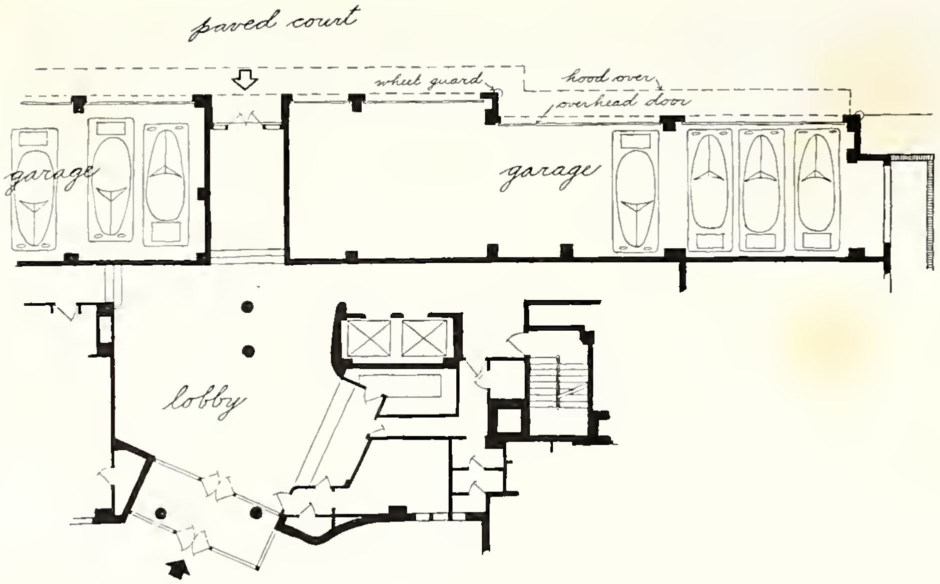


Fig. 228.

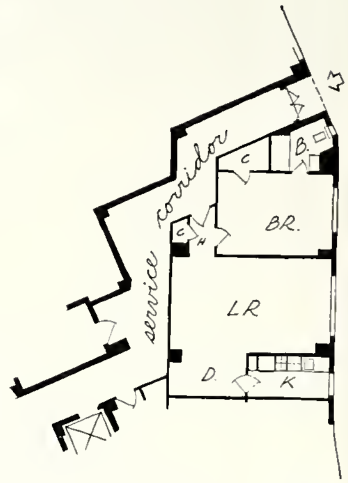


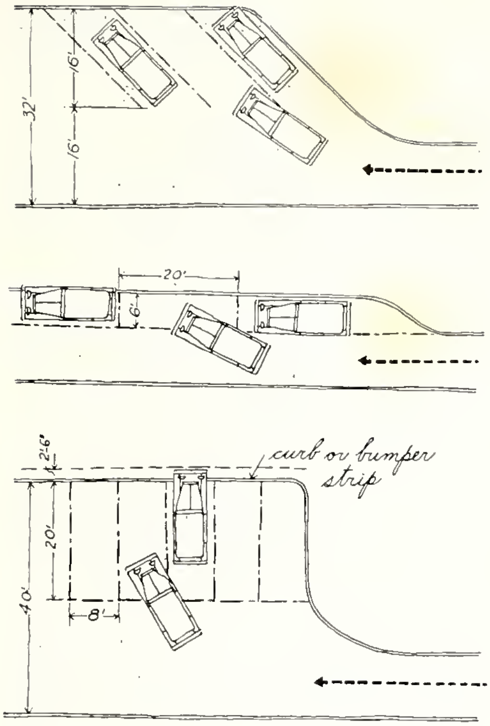
Fig. 229.

Garages and Parking Spaces

Garages for apartment buildings may be in separate structures or may be built into the lower stories of the building itself, or, they may be a combination of the two (Fig. 228). Access, in as direct a manner as possible, should be provided so that tenants may reach their cars easily. Garages or parts of garages which extend under the apartment building proper are always bound to contain a good deal of waste space as car spaces and driveways must be arranged to fit the column layout which best fits the apartment units above. In making such garage layouts it is frequently possible to make minor column changes which will be of advantage to the garage layout, but this adjustment must never be at the expense of interference with the apartment units. The elimination of certain columns in the basement which interfere with the garage layout by carrying them on girders is possible, but should be avoided except in extreme cases as this is usually an unduly expensive expedient.

Garages which are built free of the main structure are free from this difficulty and may follow standard garage practice in layout. Clearances should be ample, bearing in mind the fact that in general cars will be parked and removed by the tenants themselves and that they lack the skill for getting in and out of small spaces which is acquired by regular garage attendants. Inclusion of other facilities such as wash racks, gasoline pumps, etc., is dependent upon the size of the garage and the demand for such services.

Building codes are generally quite strict in their requirements relating to garages located in the lower stories of apartment buildings and these requirements should be carefully checked before incorporating garages in the building plans. They generally require completely fire-resistive construction in the garage portion, class "A" fire doors at every entrance into the main building, and under some conditions they also require mechanical ventilation and sprinkler systems. Off street spaces for car parking should be provided in a convenient location with respect to access to build-



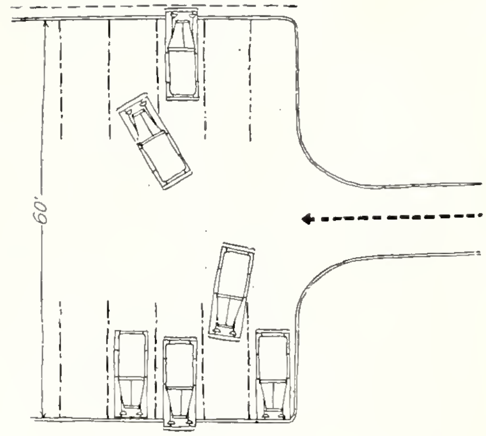


Fig. 230.

ing entrances. At times this may be economically combined with service and delivery driveways. In large projects a number of small spaces for parking is better than a few large spaces for they may then be located so as to reduce walking distance to building entrances. The smaller parking areas may also be landscaped to give a better appearance. For parallel parking a space of 6 feet by 20 feet per car should be allowed, with a space for a 30 inch overhang for cars parked against a curb, or bumper strip. For a single row of cars parked perpendicular allow 40 feet for car space and driveway, for a double row of cars with center drive allow 60 feet (Fig. 230). Approach drives should not be less than 10 feet wide, nor should they be much wider unless it is intended that cars should be parked on them.

Service Entrances

General service entrances should be carefully located to facilitate the handling of furniture for tenants moving in and out and for daily use of delivery boys. Access should be provided to stairs, elevators, and to the desk in the lobby as previously discussed. Space should be provided outside of the service entry for parking trucks and delivery vans. For large buildings a loading platform located under a projecting canopy is very useful (Fig. 227). A large canopy will help considerably in protecting the apartments immediately above the service entrance from annoyance caused by noise and fumes from trucks.

Elevators

Passenger elevators should be used for all buildings over 3 stories in height. Where building height exceeds 5 stories tenants should have access to not less than 2 elevators without having to walk more than one floor, either up or down, during periods when one elevator is out of service. Elevator cost varies considerably according to car size, speed, and type of controls and operation. For good service in buildings of more than 5 stories a car speed of 350 feet per minute is recommended. Best elevator efficiency is obtained with 2 elevators for each 100 to 125 apartments. (See Chapter 4 for further discussion of the number of elevators required.)

Where conditions justify its use, in buildings of large enough size, a separate elevator for freight and service may be provided. Freight elevators may be of slower speed than passenger elevators, about 200 feet per minute being usual. Freight elevators may also be used to supplement passenger service during periods when one of the regular passenger cars is out of operation.

Practically all apartment building elevators are now being arranged for fully automatic operation in order to eliminate the high cost of elevator operators. There has been no objection to automatic operation on the part of tenants when modern types of equipment have been used. Automatic operation was objectionable in the early stages of its development. Tenants particularly objected to having to open and close heavy elevator doors. The use of fully automatic doors has, however, overcome this objection. Fully automatic controls will cost from six to seven hundred dollars per door, but will prove a good investment.

In some low rent projects savings have been effected by having elevators stop only at alternate floors, omission of doors and controls will save about nine hundred to a thousand dollars per floor but subjects a large number of tenants to the necessity of having to walk up or down one flight to reach their proper floor. Where paired elevators are used stops at alternate floors for each elevator may be arranged so that tenants will have to walk only when one elevator is out of service. It is questionable whether these systems save enough to make up for the inconvenience sometimes involved in their operation, and their use should certainly be confined to the lowest rent type of buildings.

Garbage and Trash Disposal

The only really practicable means for disposing of garbage and trash is by means of incinerators conveniently accessible to every tenant. The expense of disposal on the part of the management is then cut to a minimum, all that needs to be done is to tend to the burning of the material and the removal of ashes, the ashes having only about 1% of the bulk of the original trash and garbage. Other schemes which involve door to door collection or the bringing of refuse to central collection stations are never sanitary or satisfactory, either from the viewpoint of the tenant or the management. The expense of collection and removal of waste is much greater than where incinerators are used; they are unsightly and inconvenient, and the use of such systems cannot be justified on any grounds whatsoever.

Incinerators should be located within easy access of all units. In corridor buildings they should be spaced not over 150 feet apart and should be located in a closet set back from the corridor. The closet should be large enough to hold boxes and other debris, which is too large to be put down the flue, for collection by the janitor. Large incinerator doors with hydraulic closers make the best and most durable installation. Settling chambers located on the roof should be provided for tall buildings to reduce the draft and prevent trash and soot blowing out of the flue. In group plan buildings it is preferable to have an incinerator located in each stairhall. Where this is not practicable incinerators are sometimes located on the end of each row of buildings in which case they are fed from the outside only. Outside fed incinerators may also be used on the ends of rows of duplexes.

Exterior Facilities

Roof gardens, when properly planned, provide a pleasant and useful space much appreciated by tenants and are a sound investment for the owner because they help him obtain better rents and avoid vacancies (Figs. 208, 209, 210). In planning them,

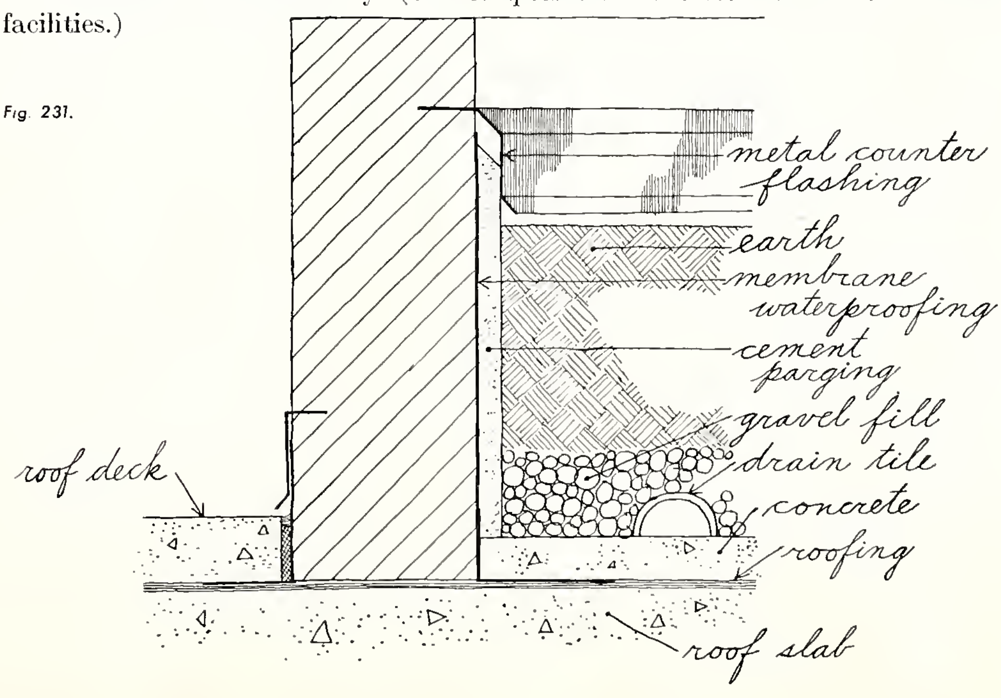
allowance should be made on the structural plans for the weight of planting areas, increased live loads due to human occupancy, and consideration must be given to providing proper means of egress (see also Chapter 6).

Roof garden areas should be enclosed with a high masonry parapet, chain link fence, or other secure protection. Use of fencing avoids the cracking and leakage frequently encountered in high masonry parapets and has the further advantage that it can be set well in from the edge of the roof, providing a safety measure against the inevitable show-off who is likely to perch on a parapet and topple over. All areas to be walked on should be paved with a protective covering and judicious use of sun shelters, wind breaks, decorative walls, and trellises provide an opportunity for many interesting effects. Vent stacks which come up in the roof garden areas should be carried up at least seven feet above the roof. They may be treated decoratively as vine trellises to conceal their stark appearance. Suitable garden type furniture should be provided and consideration must be given to the location of all the various roof appurtenances such as radio aerials, chimneys, ventilating fans, etc.

For roof planting the depth of earth required is as follows: for flowering plants 12 inches, for small shrubs 24 inches, for trees 36 inches. Earth should never be placed directly on the roof surface. It should be placed over from 4 to 6 inches of gravel and between the gravel and the roofing membrane there should be a 2 inch protective layer of concrete (Fig. 231). Membrane waterproofing and cement parging should be carried up the sides of planting boxes to the earth level and should be capped with metal counter flashing. Large planting areas should have half-round drain tile laid about 15 feet on centers leading to a suitable roof drain. All planting areas must be well drained or a swampy condition will result. For good results soil should be fertilized at least once a year and preferably twice. Due to exposure to wind and sun frequent watering of planting is necessary.

Care should be exercised in the selection of plants for very high buildings to chose those which will stand high wind and exposure. Trees which have proven satisfactory are willow, crab-apple, Douglas fir, elm, honey locust, Oriental plane, and maple. For hedges Asiatic yew and privet, for vines wisteria, bittersweet, honeysuckle, and morning glory have done well. Almost all small plants of both bulb and root varieties are satisfactory. (See Chapter 5 for a discussion of other outdoor facilities.)

Fig. 231.



CHAPTER 8: Trends

Services

There is a noticeable trend toward the further mechanization of tenant and operating facilities for apartment buildings, the objectives being greater efficiency and reduced labor costs. During the war, with the increased difficulty of obtaining competent employees and the upward curve of all wage scales, this trend was given added emphasis.

Hand fired boilers are now entirely obsolete in new buildings and most existing buildings have converted to automatic heating devices. It is the general opinion of building managers and operators that the most advanced systems of heating control save many times their cost over a period of years both in labor and fuel cost, as well as resulting in added comfort to tenants. Lack of proper temperature controls on many systems installed before the war resulted in too much heat in most rooms, with the result that many tenants opened their windows to cool rooms to a comfortable temperature. Installation of proper controls eliminates this source of heat loss, and conversion of existing faulty systems of heating has resulted in fuel savings of from 30 to 50%.

Radiant heating systems are being considered for many postwar buildings. They are especially advantageous in view of the trend toward use of larger glass areas which make the convenient location of adequate radiators increasingly difficult. In any case, with radiant heating the complete elimination of radiators is a big advantage, saving housekeeping work and offering more freedom in the placing of furniture. Installation costs of such systems according to present estimates promise to be no more than the costs of the systems previously used and may in the future turn out to be much less. In multi-story buildings the best location for radiant heating panels seems to be in the ceiling. Pipes can be attached to the underside of slabs and be buried in the plaster. Wall panels and baseboard types of radiation are also being studied and their use in certain types of construction may be advantageous.

Types of control vary, from zone control, in which various portions of a building are controlled separately according to exposure and prevailing winds, to individual controls located in each apartment and, in a few cases, to individual control of each room.

The use of complete air conditioning in such climates as demand it is an attractive rental feature and has been successfully used in a number of buildings in Washington, D.C. However, it is very expensive both to install and operate and its use must be confined to buildings of a fairly high rental level. It should further be noted that complete air conditioning is not desired by all tenants and consideration should be given to the possible future installation of individual room units.

Mechanical ventilation for corridor type buildings has had widespread use in Washington, D.C., for the last fifteen years, and today is incorporated in the plans of practically every new building that is not air conditioned. Fans are located in fan rooms in the basement, and their size is based on their capacity to handle a sufficient volume of air to provide a complete air change in all habitable rooms every two minutes. The velocity of the air in the vertical ducts is figured at about 1200 feet per minute; registers on each floor are provided with fire dampers, and all air is filtered before entering the fan room. Building corridors serve as plenums for the horizontal distribution of air, which is admitted to apartments through louvred doors.

These ventilating systems are economical to install and their operating cost is very little. Building managers report great satisfaction with their use, and tenants appreciate their benefits; as is evidenced by the fact that managers report that there is an instant stream of complaints if the fans are turned off even for a few minutes during hot weather. Fans are of course operated only during warm weather, there being enough air flow by gravity alone to provide corridor ventilation during cool weather. In very long corridors vertical ducts should be spaced at intervals along the corridors. This provides better control of air distribution than is possible if one large duct is used.

The use of mechanically ventilated inside baths in apartment buildings has been permitted in Washington, D.C., only in the last few months, although their use has been permitted in many cities for a long time. Their use permits much greater flexibility in unit planning, and in many cases provides considerable saving in construction cost. Examples of their use in unit plans are shown in Chapter 4. In most cases, inside baths allow a highly efficient use of the exterior perimeter of the building, and a corresponding reduction in the amount of wasted inside dark space. A maximum number of habitable rooms per foot of exterior wall are thus obtained. The bathrooms themselves do not suffer from their inside location, as there is no objection to the use of artificial light in bathrooms, and the quality of ventilation obtained is superior to that obtained in outside bathrooms. Their use in multi-story buildings is highly recommended in all cases where plan study shows them to be advantageous to the building design.

The use of inside mechanically ventilated kitchens which was formerly permitted in Washington, D.C., and which is permitted in many other cities is now prohibited here, although I cannot see any valid objection to their continued use. Their use

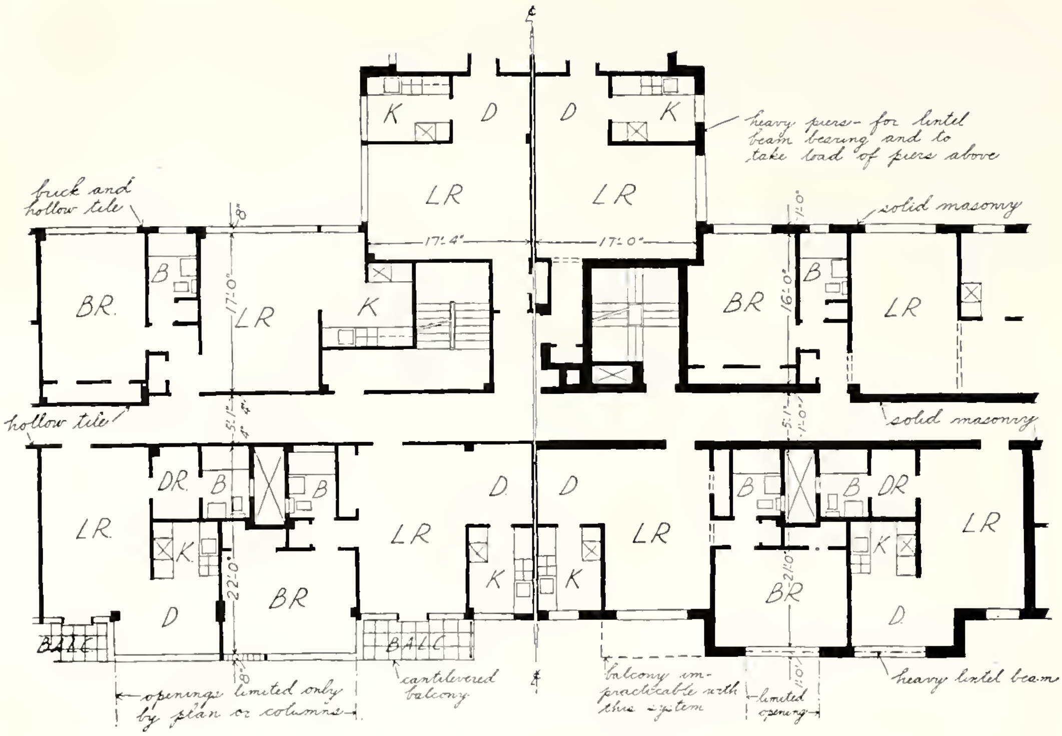


Fig. 232.

frequently permits better unit arrangement with no loss in usefulness, convenience or sanitation, and is also recommended in localities whose laws permit their use, especially in conjunction with efficiency units.

Much remains to be done in improving the design and construction of kitchen equipment. Improved designs contemplated by several manufacturers have been published, but so far this equipment has not appeared on the market. Integration of such items as ranges and refrigerators into other kitchen equipment, providing smooth unbroken surfaces, eliminating unsightly and unsanitary cracks which now exist between these units, would be a big improvement. Numerous changes in basic design of refrigerators have also been promised, including use of sliding drawers in place of doors as used at present and incorporating deep freeze chests, special compartments for bottles, etc. Design, arrangement, and capacity of other kitchen equipment is also receiving much study and improvements in these respects should soon be forthcoming.

Elevators are now equipped with fully automatic control for tenant operation, and even in those cases where it is decided to retain the use of elevator operators, duplex controls for either operator or tenant use are provided so that operators may be used only in rush periods if so desired. Many existing buildings are adding fully automatic controls to existing car switch operated elevators. Tenant acceptance of automatic operation has been good; managers report no complaints when systems have been changed or when operators have been removed from cars with duplex controls. There has been a tendency for some time towards the use of higher car speeds than have been generally used in the past. The most frequently used speed at present is 350 feet per minute for passenger cars and 200 feet per minute for freight and service cars in buildings from six to twelve stories in height.

There is a decided trend toward the use of skeleton frames, even for buildings only

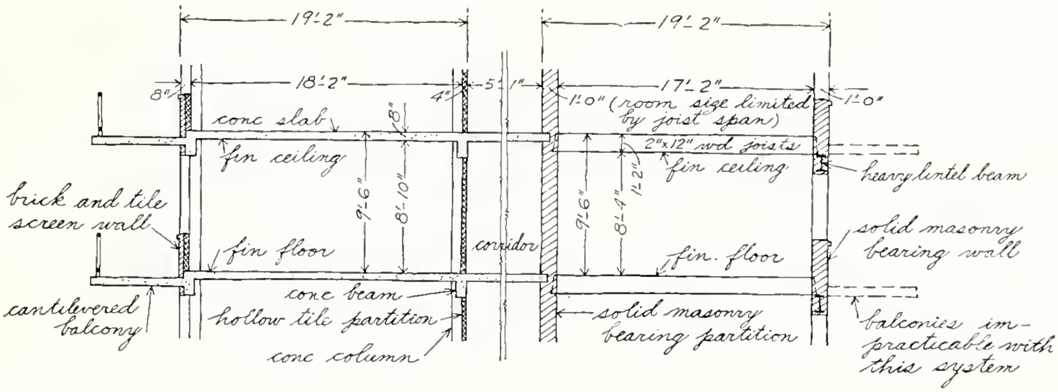


Fig. 233.

three stories high. With present ratios of building material costs the skeleton frame is less expensive than the heavy masonry bearing walls required for wall bearing buildings. The use of the skeleton frame has, however, more advantages than the saving in cost. It offers flexibility and freedom in the planning of units, and permits better spacing and location of large windows. Where masonry bearing walls are used care must be taken to leave piers of sufficient size and in proper locations to carry the building loads, and windows eight feet or more in width must have fireproofed lintels, which are expensive to provide. Figures 232 and 233 show graphically a comparison between two portions of the same building, one portion being designed as a wall-bearing structure and the other with a skeleton frame. It is, of course, possible to support the corridor slabs on columns and beams and thus eliminate the heavy interior bearing partitions, but this is doing the job half-way and eliminates a great many of the advantages which may be gained from the use of a full skeleton frame. Skeleton construction also allows of more speed in construction, as the entire building frame can be erected without waiting at each story for masonry walls to be put in place. Another consideration in favor of skeleton construction is the much greater ease of making future changes in layout. Variations in plan can be made to suit individual tenants, or as neighborhood conditions change, units can be enlarged or reduced to suit changing demands with much greater ease than would be the case if bearing partitions had to be considered. Figures 234, 235, and 236 show three different apartment arrangements using the same column, window, and plumbing stack arrangement. These changes could be made at any time with a minimum of expense, as the only changes required are in partitions, finishes, and the installation of plumbing on existing vertical stacks. The scheme shown in Fig. 234 has three two-bedroom apartments, one of which has two baths. Figure 235 has the same number of units, but one has now been converted into a larger unit with three bedrooms and a dining room. Figure 236 shows the same space arranged as five apartment units, three efficiency units, and two one-bedroom units.

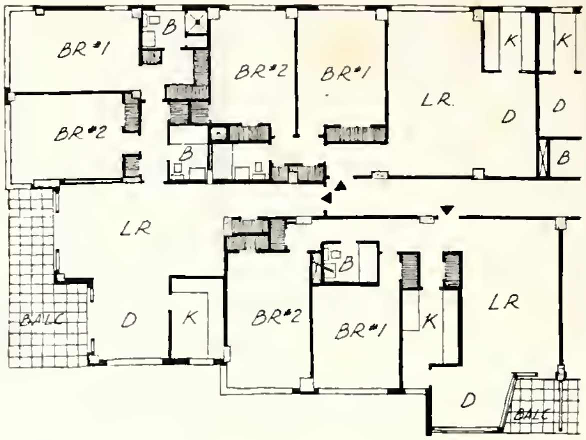


Fig. 234.

It is entirely possible that at some future time apartment space might be rented much as office space is today; the tenant renting so many square feet and subdividing the space to fit his own requirements. Elements of circulation, baths, and kitchens would need fixed locations but the balance of the space could be arranged in various ways at the desire of the occupant. Many old buildings suffer from the fact that they were laid out originally as large luxury units, and, due to changing neighborhood conditions, there is no longer a demand for their type of units. As usually planned and constructed these buildings are exceedingly difficult and expensive to replan into smaller units.

Proposals have been made to tear down all buildings after they have reached a certain age, but I believe that a large part of this necessity could be avoided if due consideration was given in the first place to proper site planning, integration with city plans, and construction of a proper permanent building core which was susceptible to comparatively simple remodeling. A properly built building frame and core can last almost indefinitely, if so designed that utility piping is accessible for repair and renewal. The trouble with most depreciated buildings today is that they were not properly designed in the first place.

In several large cities today building codes have recently been changed to eliminate the requirement for masonry walls on skeleton framed, fire-resistive buildings, permitting in their place thin panels of an incombustible material. Such panels are now in the process of development and their use should in the future contribute materially to cost reduction in multi-story buildings. (See engineering section for examples of various wall sections.) Reduction in weight of such panels should allow considerable savings in the building frame, as well as savings in the cost of the walls themselves. In addition their thinness will allow for increased area in the apartment units or a corresponding reduction in the size of the building itself.

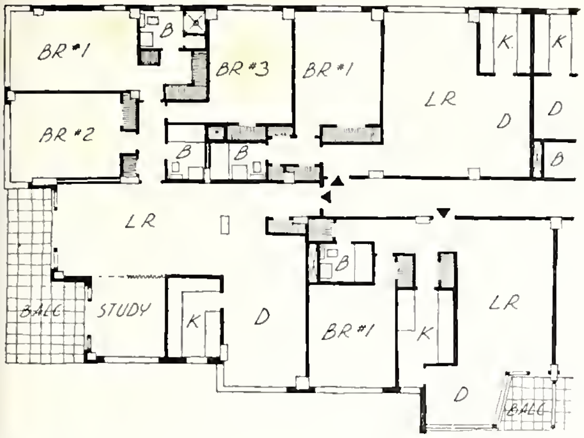


Fig. 235.

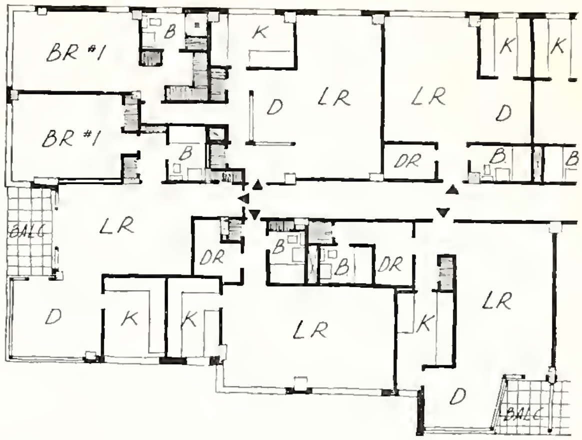


Fig. 236.

New types of interior partitions will also contribute to savings in space and cost. Among these is the two inch solid plaster partition which has been successfully used on a large number of projects. Such partitions have a core of gypsum lath or metal lath, plastered both sides, resulting in a finished thickness of 2 inches or less, compared to 4½ inches or more for conventional types of partitions. Various types of dry wall partitions have been tried in war housing projects, but as yet have not been developed to the point of being acceptable for use in permanent housing. There are many advantages possible for dry wall construction and the development of new types suitable for permanent construction probably will be forthcoming soon.

There are many possibilities yet to be explored along the lines of partial prefabrication for component parts of apartment buildings. Among them such items as prefabricated piping for baths and kitchens, pre-fitted and finished doors, complete with bucks, jambs, and hardware, ready to be set in place, prefabricated closets, and other items of built-in-equipment. There is also the possibility of complete bathrooms along the lines of the pressed steel bath designed some years ago by Buckminster Fuller. Such items, if properly designed and mass produced, could give a considerable increase in quality of construction and equipment with perhaps an accompanying reduction in construction cost.

Planning

There has been in the past too great an emphasis on planning efficiency to the neglect of elements of space quality. In the effort by public authorities to provide low rent housing within the price limits set by Congress, and the effort among private operators to increase profits, the emphasis has been largely concentrated on an effort to increase the use of a given amount of space at the same time reducing construction costs. However, we should not lose sight of the true objective of housing; to provide suitable living facilities for the development of family life. More study should be done on how to make the dwelling units more livable and

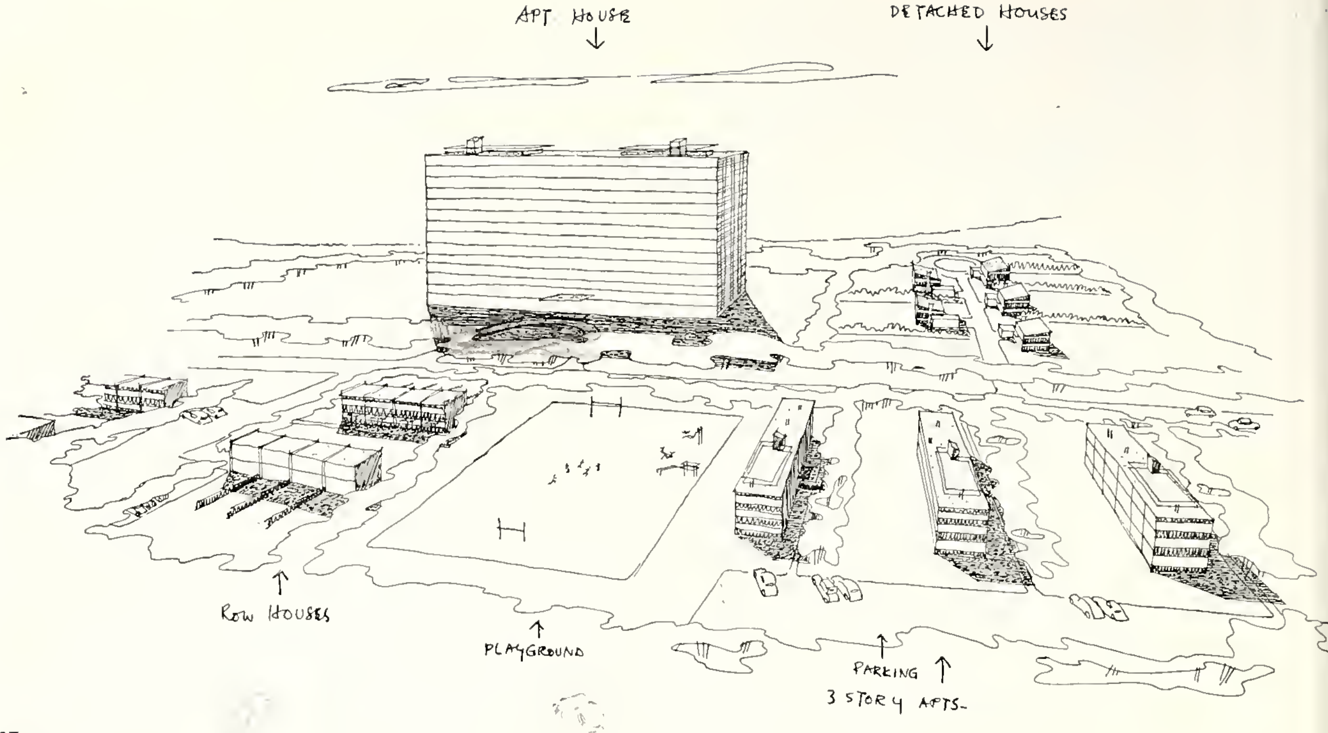


Fig. 237.

workable in accord with people's living habits and desires. There are many factors affecting the quality of space, among them the shape and proportions of the various rooms, the circulation between them, the view into the apartment on entering, the various openings in the rooms in relation to the furniture and equipment to be used in them, the amount of sunlight penetration and views out of the windows. It is to be hoped that in future buildings more emphasis will be placed on the study of these factors.

There has been a limited trend towards very large projects, housing many thousands of people, particularly on the part of insurance companies. Those which have been built, or whose plans have been published, such as Parkchester and Stuyvesant Town, in New York, and Fairlington, in Virginia, have been highly conventional in design and have not taken advantage of all of the opportunities which their large scale operations and vast size have offered. Large scale projects of this sort need, for their own protection, the most careful integration with city master plans and a complete development within themselves of self-contained neighborhood facilities. The bringing together of many thousands of people into one project presents many problems which are present only to a minor degree in the ordinary small building or group. Design of the site plan and of the buildings themselves should endeavor to create an atmosphere of livability and an avoidance of monotony, particularly from the viewpoint of a pedestrian approaching the project or a tenant looking out of one of its windows.

One step in this direction which has been advocated by several planning authorities would be the planning of mixed neighborhoods containing detached and row houses as well as apartment buildings (Fig. 237). The principle of zoning by use or type of building causes a segregation not only of building types, but of income and social groups as well, and does not accomplish what should be the proper objective of

zoning laws: the control of population density and an insurance of adequate light and air for all dwelling units. The development of neighborhoods containing tall apartments properly spaced in conjunction with detached houses and duplex apartments offers great possibilities advantageous to both types of dwellings through the possibility of variations in form and mass, and the preservation of suitable open spaces, and economically through the more efficient use of land. The great possibilities of more efficient design through control of population density rather than control of building bulk should receive careful consideration. Prejudice against the erection of high buildings has resulted largely from their being crowded together instead of being properly spaced. The many studies by Le Corbusier of skyscrapers spaced at great intervals with low buildings interspersed between, present in dramatic form some of the advantages this type of planning has to offer.

Building Codes

There is on foot at the present time a great concerted movement among groups representing government, builders, and professional men to revise and bring up-to-date the conflicting mass of building codes with which the building industry is now afflicted. Building codes vary in their requirements from city to city and from state to state, presenting great difficulties to manufacturers of building materials, who must try to make their products conform to them.

Much undue expense is caused by excessive or restrictive requirements for structural design, fireproofing and exit requirements. In many cases their requirements are far in excess of the standards generally accepted as necessary in the public interest. While in some special cases design must vary to conform to local conditions, as for instance for localities subject to frequent earthquakes, there are in most cases no valid reasons for most conflicting regulations in different localities. A beam will support the same load under the same design conditions in Florida as it will in Oregon; people in all states are approximately the same size and breathe about the same amount of air; and the only reason for one city requiring ½″ thick gypsum lath when all others use ⅜″ lath is obviously to prevent the use of gypsum lath at all. Provisions of this sort of which there are a great multitude have, in the end, the effect of lowering the efficiency of building design and of increasing building cost, and as usual it is the public who pays.

An aroused public opinion could quickly bring about a revision of codes in accord with good engineering practice, recognized health requirements, and proper standards of safety. It should not be inferred from the above discussion that all the blame for faulty codes is the fault of building inspection departments. They struggle under the handicap of insufficient and frequently underpaid personnel and have neither the time nor the facilities for undertaking the frequent revision and rewriting of building codes. The writing of a good code is a truly formidable task and requires the work of numerous experts over a long period of time. In addition facilities for research on building materials are sadly lacking and a national agency with sufficient funds and personnel to investigate the qualities of old and new building materials and methods would be of prime importance. It would be to the benefit of every citizen to work for the establishment of such an agency, or the extension of an existing agency such as the National Bureau of Standards, to perform this much needed work and for a properly staffed and equipped building department in every jurisdiction. The acceptance and use throughout the nation of a uniform building code would work to the advantage of every one, by making possible great savings on buildings of every sort.

The interest and influence of government in all matters affecting housing have increased steadily during the past few years. The probabilities are that this concern will continue on an increasing scale, resulting in less and less differentiation between large scale private and public housing developments. The many urban redevelopment bills passed or under discussion by various states and municipalities and by the federal government are an evidence of this trend. The granting of rights of eminent domain to private corporations and provisions for periods of tax exemption and limited dividends, require close government supervision of all phases of planning, construction and operation.

The necessity for providing assistance to families, whose income is not adequate for the purchase of decent shelter, is well recognized and is by now a fairly well settled part of government policy. Whether this aim is achieved by means of subsidies granted to private companies or by the direct construction of housing by the government, the end result, so far as the buildings themselves are concerned, is not very different. Most existing projects of this type have been designed with their initial cost as the prime consideration, and the effect of the buildings on their inhabitants has been relegated to second place. This condition has been caused, in the case of government housing, by the low cost per dwelling unit limitations imposed by acts of Congress, and in the case of private operators by the influence of government regulations and the lack of recognition of the possibilities inherent in good design and planning. The results are self-evident, and low cost housing is immediately recognizable anywhere by its appearance of dreary mediocrity. Their barren, monotonous, institutional appearance usually arouses the opposition of occupants of surrounding property to the erection of such projects in their vicinity. More attention paid to inviting appearance, and a little money spent in achieving it would in the long run pay big dividends, both in satisfaction to the tenants and in cash to the owners of the project. The mere fact that this is true will not cause anyone to believe it.

It will be pointed out that most buildings which failed financially during the depression did so because they were over-financed, and had been "milked" by their owners to the breaking point. It will also be pointed out that, in general, the operating profits of large apartments have been so great that they would show a profit in any case, if they are properly financed. These things are also true. In most cities, any apartment project, well designed or poorly designed, if handled with a modicum of common sense and mortgaged for not much more than its actual cost, would show a substantial profit to its owners.

It is hardly reasonable, however, to believe that this will always be so. Once the supply of housing begins to catch up with the economic demand, which it is liable to do someday, the well designed and attractive project will show its merit. A properly constructed and designed apartment building should last at least fifty years, and an average vacancy of 10% during this period will amount to as much as the entire initial project cost. Another factor to be borne in mind is that in many cases a good design may cost no more or even less than a poor one, both in first cost and in operating cost.

The influence of government in the financing of housing projects, through such agencies as the Federal Housing Administration, the Federal Home Loan Bank System, the Reconstruction Finance Corporation, the Home Owner's Loan Corpo-

ration, etc., has been enormous. By its influence on the volume of credit, and by the setting of interest rates, the Federal government exercises a large degree of control over the volume of building. Through its policy of mortgage insurance it also exercises considerable control over the planning and design of many apartment buildings. This influence will probably increase in the future.

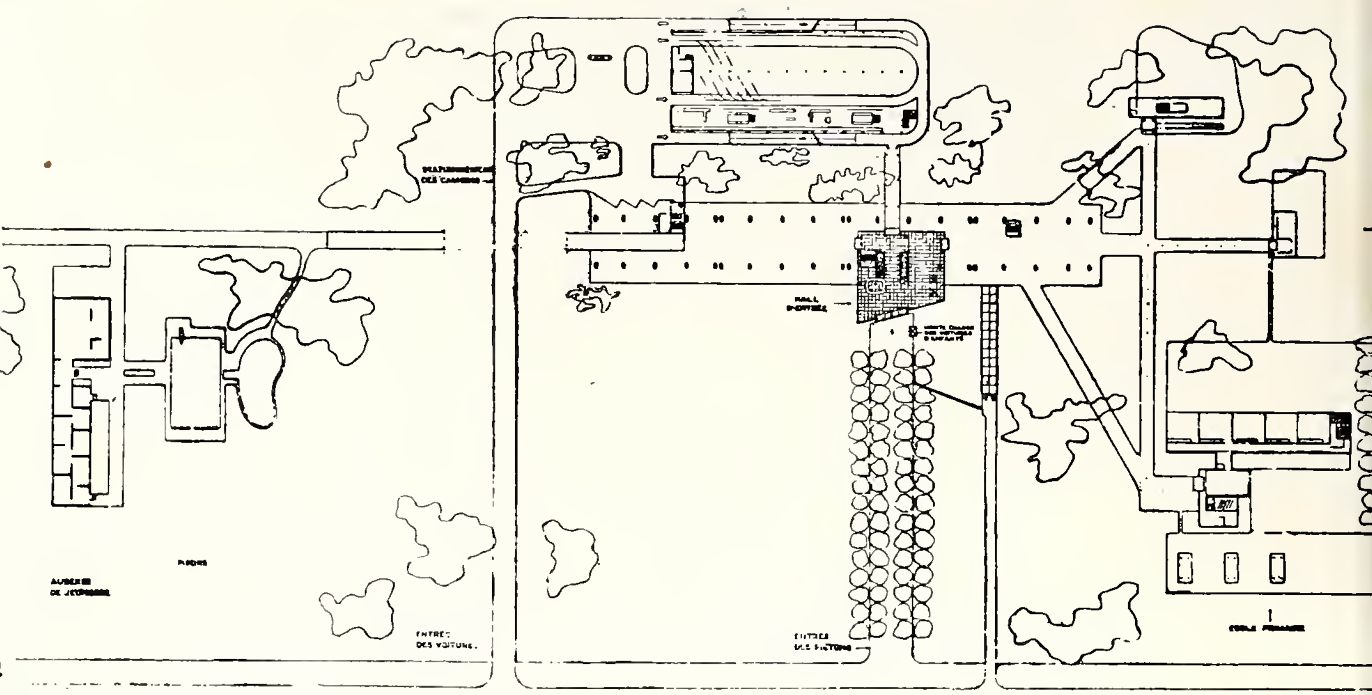
The influence of city planning commissions will probably result in more extensive controls of land use and neighborhood development. This control if wisely exercised in competent hands can be a tremendous influence for the development of better housing. If incompetently exercised it will result in more strangling, useless regulations, of which we already have an ample supply.

The lack of facilities for extensive technical research on building methods and materials has already been pointed out, as well as the lack of reliable statistical data on demand, construction costs and operating costs. Development of such facilities and the regular publication of findings on these and other related matters would be a service of great importance to the public as a whole. Work done to date by various government agencies has had a tremendous influence and is a positive indication of the value of planning, technical, marketing, and statistical research. The publications of such agencies as the Federal Housing Administration and the Federal Home Loan Bank Board have contained a wealth of valuable information on both planning and financial matters. The National Housing Agency has made important contributions to the establishing of standards for low-rent housing and to research into living standards, customs, and desires of tenants. The National Bureau of Standards has done considerable work on the testing of various building materials, and in the formulation of model building codes. The Forest Products Laboratory has conducted extensive research into the properties of wood, and has developed uses for plywood making extensive use of the stressed skin principle of design. Valuable statistics have been compiled and published by the Bureau of Labor Statistics of the Department of Labor and the Department of Commerce has published a Real Property Inventory and Financial Survey of Urban Housing. All of these publications have, however, only been a beginning. Lack of funds has prevented a proper development and coordination of all this work, a situation which should be remedied as soon as possible.

Cooperation between Architects and Engineers

Every successful building must represent a complete coordination of the efforts and skills of many persons. With the increasing complexity of modern buildings the cooperation of architects and engineers becomes more and more important. The architect should be sufficiently versed in structural engineering methods and procedures to be able to discuss them intelligently with his engineer and be in a position to help make a correct choice between the various framing methods that may be used. The engineer should have a thorough knowledge of modern methods of framing and their analysis. Far too many buildings are built using outmoded structural systems because their engineers are unwilling or unable to apply modern methods of engineering design.

The increasing complexity and amount of mechanical equipment used in modern buildings calls for skillful design and coordination of this portion of the work. Space must be provided in the structure for the equipment used and the multitude of risers, ducts, shafts, etc., that are required. As has been pointed out in an earlier chapter, the cost of operation of mechanical equipment is a large factor in the rent



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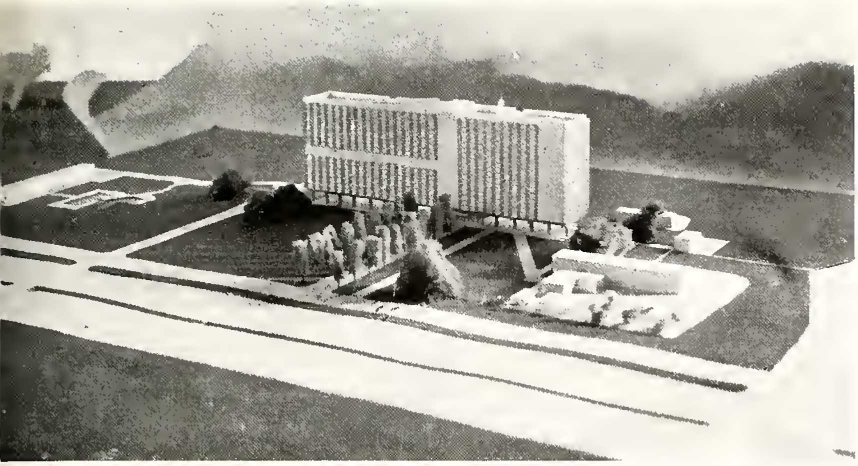
which must be charged to make a building a profitable investment. This cost is influenced to a tremendous degree by the type of system chosen, by the skill with which it is designed, and by the adequacy of its installation. An unsuitable heating system or a poorly designed one may result, for instance, in a fuel consumption double that of a properly designed system. The use of unsuitable or inadequate materials and equipment, or the improper installation of them, usually results in high maintenance costs. Good engineering design and supervision will avoid these unnecessary expenses.

On large projects the importance of proper road, driveway, grading, drainage, and planting design will require the services of a civil engineering consultant and a landscape architect. Here again the decreased maintenance costs resulting from proper design will pay for such services many times over in the course of a few years.

Little use has been made on apartment buildings of the services of painters, sculptors, or other artists, as has been done on some other types of buildings. Rockefeller Center in New York City is an outstanding example of such collaboration. There are many possibilities on apartment buildings for the use of various arts. Wall mosaics, mural paintings, integral or free standing sculpture would be appropriate in many lobbies, entrances, gardens, and other places, and their use should be considered whenever possible.

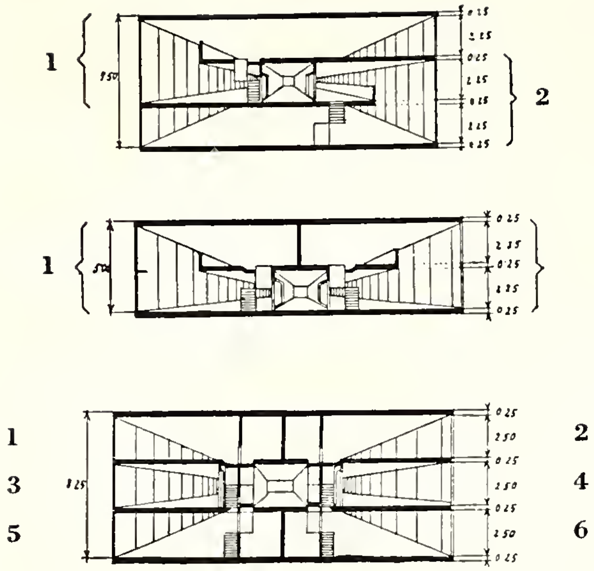
It should be emphasized that the proper time for collaboration to begin is at the beginning of the project. If, as often happens, the calling in of engineering consultants is deferred until the preliminary drawings are finished many of the advantages of collaboration are lost, and the provision of adequate spaces for columns, beams, risers, shafts, and equipment is made immeasurably more difficult. Collaboration should start at the very inception of the project so that every element of the building may be properly integrated into the design.

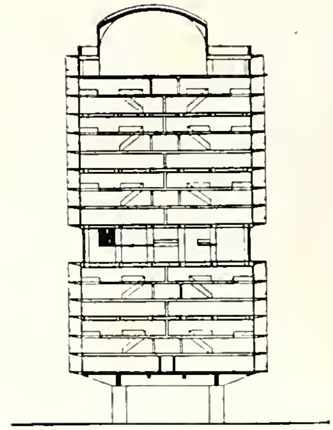


This apartment house in Marseilles is 140 meters long, 22 meters wide and 50 meters high. It will contain about 350 apartments and house about 1,500 persons. It was designed by Le Carbusier.

Owners and builders of apartment buildings have very frequently been reluctant or have refused to bear the cost of competent engineering services. Many buildings have been built with structural frames designed by engineers in the employ of building material houses, whose services were offered free, providing their employers received the order for the materials used. Still more buildings have been built with heating systems laid out by plumbers, with no mechanical engineers being employed at all. Ninety-nine times out of a hundred such practices result in higher first costs, higher operating costs, and higher maintenance costs, because competent services are not obtained by this method.

Two similar eight story concrete framed apartment buildings built in Washington, D.C., in 1938, furnish a good example. The first of these buildings was designed by an engineer employed by a steel company and the second by a consulting structural engineer. The per square foot cost of the finished concrete work in the first building was five cents more than that in the second making a total difference in cost of about $4,500 for the concrete work. In addition the space lost in the first building through excessive column sizes was considerable. Another example is that of a building in which an unlined hot water storage tank was installed at a saving in cost of about $1,000 over the cost of a lined tank. This economy has resulted during the first six years of operation in the spending of about $1,500 for repairs which would have been unnecessary if the lined tank had been used. Furthermore, this expense will recur at periodic intervals, because the tank cannot now be replaced without tearing out a large part of the side of the building. Still another example is the case of a building erected in 1941, in which a recent inspection of the heating system by an engineer revealed that a large number of valves and controls had been improperly installed and consequently were not working properly. These valves and controls were fixed and further minor changes were made in the system at a total cost of about $1,200. The result was a lowering of fuel costs by slightly more than $600 per year. As long as the owner must pay either the cost of competent professional





Typical sections through apartments and building. Morseilles Apartment House, Le Corbusier, architect.

services, or higher building and operating costs; his choice should be obvious. The employment of competent architectural and engineering services is the only way in which he can get his money's worth.

"Dream Projects"

The best apartment designs of such "impractical dreamers" as Le Corbusier and Frank Lloyd Wright have never been built. They are scorned by the "practical mind" as being hysterical, romantic, fantastic, or impossible. Opposition to such schemes does have a "practical foundation." Wright's design for Crystal City, in Washington, D.C., for instance, would have accentuated to a marked degree the shabbiness and mediocrity of its neighbors, had it ever been built. Conservative owners of large real estate holdings, and lending institutions with an eye toward the stability of their mortgages, naturally oppose such a contrast on account of its possible depreciation of their investments.

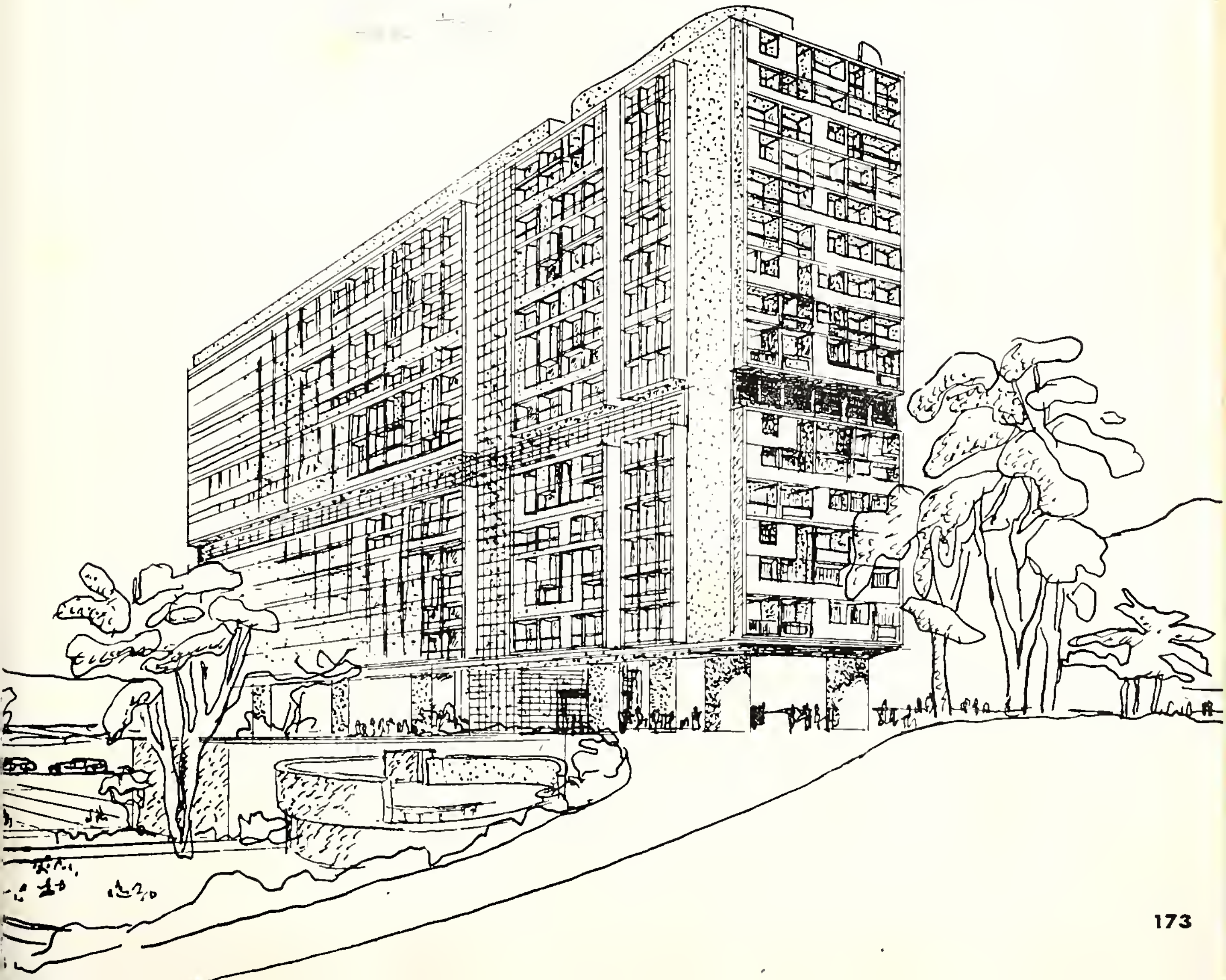
The vast projects of Le Corbusier published in "La Ville Radieuse" would, if executed, entirely destroy the possibilities for speculation in land and real estate. The execution of such a scheme would necessitate complete control of all land by the municipality and would involve the razing and removal of practically all existing structures.

The example of Radio City, in New York, has demonstrated the powerful effect that large new structures can have on their surroundings. If they are of such a size as to cause an over supply of accommodations, they are able to attract tenants from other buildings by offering better accommodations and reduced prices. This may be good for the tenants, but it is bad for the owners of the other buildings, who are left with a lot of vacancies, or are compelled to reduce their rents in order to meet the competition. Parkchester, in the Bronx, N.Y., is another example. The rents in this project are established in relation to the cost of the project and the return desired by the company on its money. The result is that the rental scale is considerably less than what the market would bear, and it is very much lower than the prevailing rates in other existing buildings in the borough.

The trend previously mentioned towards the development of large projects of this nature offers one of the most promising means towards the reduction of cost of rentals. Large scale production and operation offers possibilities for large savings both in capital and in operating costs. The relative efficiency of operation of large projects as against small buildings should show savings of as much as forty percent in operating costs.

The Future

The net effect of all these trends on the future of apartment design is unpredictable, although the problems posed are clear. In order to furnish an adequate supply of really habitable apartment units properly integrated into a satisfactory neighborhood pattern sweeping changes in existing methods are necessary, involving many related factors. A successful building is the product of a combination of good design and good construction. It needs an adequate city plan and government controls to create and preserve the needed neighborhood facilities and environment, and it requires proper financing methods and wise management and maintenance policies to enable it to be a sound and profitable investment. In the final analysis no building can be entirely self-sufficient. Its continued success from the point of view of either tenant or owner is dependent on a successful correlation of all the many factors that have been discussed throughout this book. If our progress in the future continues at the same rate as in the past, the necessary changes in our standards of design and in our methods of construction, city planning, land use, government regulations, real estate taxation, financing, management and operation will take a long, long, time.



PART 2: Structural Design

BY FRED N. SEVERUD

CHAPTER 1: Introduction

Elaborating on the known methods of calculating loads and stresses, information about which can be found in innumerable handbooks, would be both useless and probably boring to the average reader. Therefore, with one exception, we are not attempting to give this basic information to you. The one exception, "slab-band construction," will be presented in the form of tables, charts, and examples of analysis. Since this type of construction is, to my knowledge, used mainly by our office, it would not be quite fair to present all of its advantages and then ask the structural engineer who would like to consider its use to go through the agony of developing basic design methods. Another underlying factor in the form this presentation is taking, is an attempt to emphasize cardinal features. The line has to be drawn somewhere and some of the readers may think that this emphasis is done somewhat capriciously and without presentation of a complete testimony of facts. The answer to this may be annoying, but I believe it to be true: After first having worked in the field, then having executed a tremendous number of designs, making innumerable cost comparisons, attending job conferences during construction, and getting the reaction from the superintendents in the field, a good basis has been formed for evaluating good solutions to building problems.

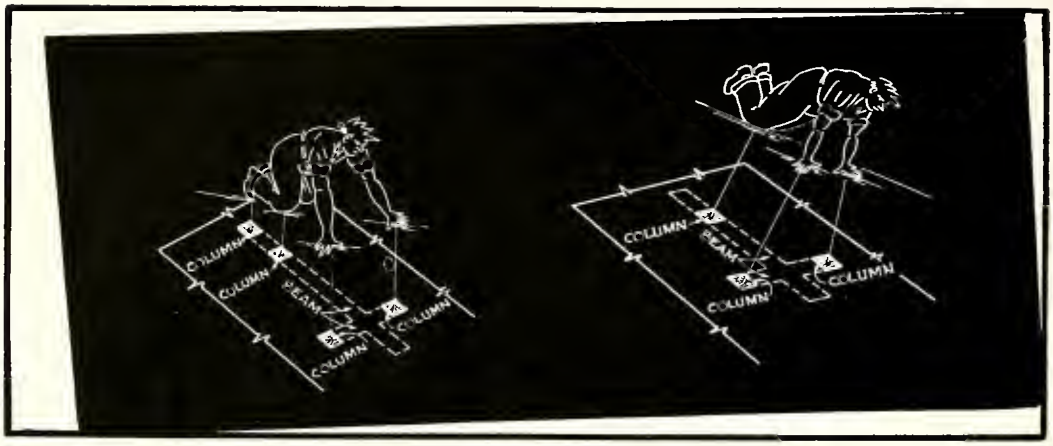
Fresh Approoch

Above all, an attempt will be made to look the problem squarely in the eye without too much regard to "standard practice." This "standard practice" has often resulted from clever calculations rather than intelligent thinking (wrongly termed "imagination"). This section should contribute toward freedom of thought in the field it covers and, therefore, your time and mine will not have been wasted.

Scope

After a short examination of the basic structural elements, there will be an *Analysis of the Building Frame*, then *The Protection from the Elements*. A preview of coming events in both of these fields will be attempted and a chapter will also deal with the various *Construction Pitfalls* and the ways to avoid them.

Fig. 1. Fig. 2.



After this guide, if you feel you would like to make the trip with me, let's be on our way!

Basic Thoughts

In apartment house construction it is more important than in most other structures to mold the framing to the spatial requirements. True, nothing is more important than to prevent the building from falling down, but the supports and framing members should be so arranged that they present the minimum interference with the use of floor space. One of the greatest obstacles to the development of graceful and direct framing methods has been the tendency of engineers to think along right angles and straight lines that most always begin and end at a column. In order to free oneself from this straight-jacket, it is well to do a little fundamental thinking. You may even have to take off your jacket, as you'll see.

There is no better way to get the "feel" of the flow of stresses than to make some simple experiments. If you feel too dignified, I'll do them for you on paper.

Lie face down on the rug. Feel the unrelenting law of gravity pulling with myriads of rubber bands. But these pulls are not requiring your body to do any work, because the pull is directly against the rug. (By the way, this is the best way I know to relax after a tiring day.)

Then get into the position shown in Fig. 1. Now you feel all those bands pulling through the air and only at the hands, the knees, and the toes does the floor prevent you from being sucked into the center of the earth. Expressed in drawing form, we get the type of construction shown. By raising the toes off the rug, we get a double cantilevered beam. You can feel the increase of pressure under your knees, and if you are sensitive, also the decreased pressure under your hands (Fig 2).

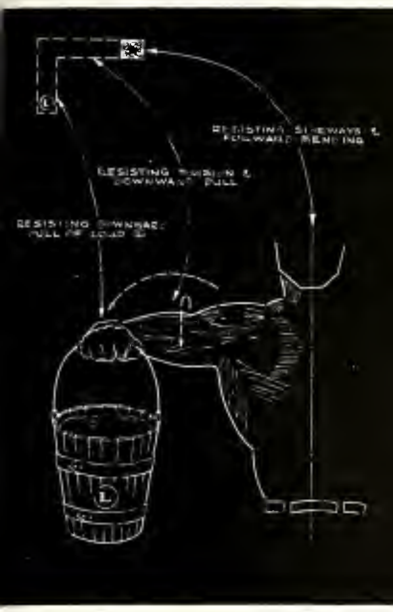


Fig. 3.

Fig. 4.

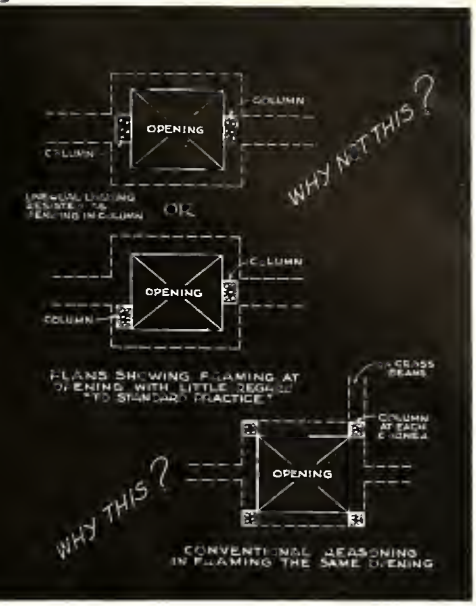


Fig. 5.

I think it would be interesting to make just one more experiment with some simple elements of carrying load. If you'll get yourself a bucket of water, as shown in Fig. 3, and hold it as shown in the sketch, you'll feel how the forearm tends to rotate around your elbow. This rotational force goes through the overarm and attacks the shoulder. The spinning force, or torsion, tries to bend the torso forward. At the same time, the overarm has to carry the load as a cantilever from the elbow to the shoulder. This action wants to bend the torso to the right. Expressing this in drawing symbols, we get what is shown in the upper left-hand corner of the sketch. The forearm is a simple cantilever, the upper arm is a cantilever also subjected to torsion, the torso is a column connected to the forearm sufficiently to resist both the torsional forces and the cantilever action. These connections, being ample, act not only to transfer the vertical load from the bucket, but also subject the column to bending in two directions. You can feel this action if you pick up your bucket again and try to sense what takes place in your right foot. The right foot presses more heavily on the floor than the left, showing the sideways action. And then again, you feel a tendency to get up on the toes of your right foot, showing that the load also creates a forward bending.

Once you have had your eyes opened to the fascinating facility with which your body lends itself as a structural model, you will recognize it as one of the greatest means of "getting on the inside of a structure." When you feel the strain on your body under awkward conditions, you can sympathize with and understand the various problems that materials have to solve. You will also realize the sweeping grace with which your body can change from beam to column, from column to catenary, and to all the innumerable in-betweens and combinations. And it does so with all members acting together to form a harmonious structural unit.

The woman shown in Fig. 4 may well say, "Why do you go to all the trouble of

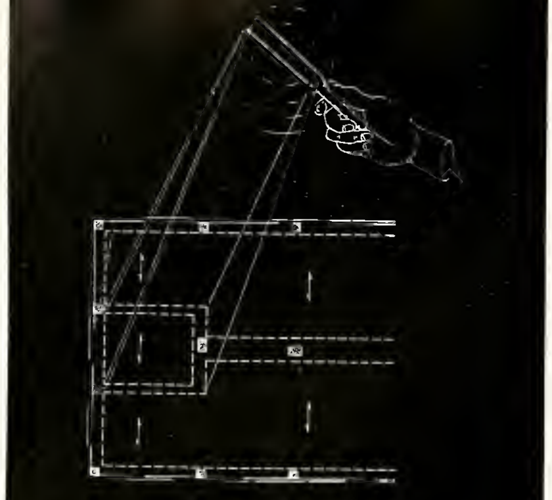


Fig. 6.

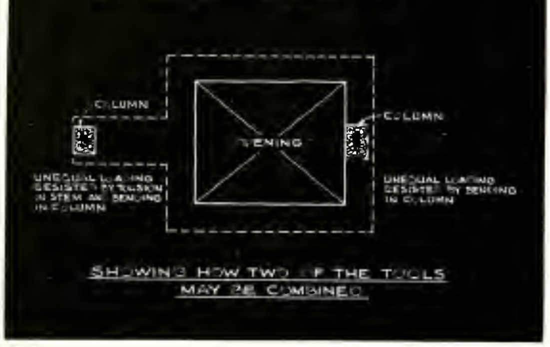


Fig. 7.

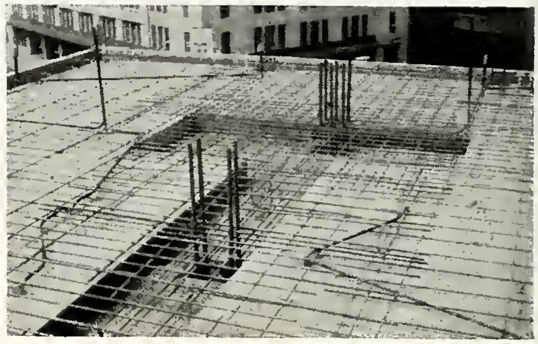


Fig. 8A.

holding the bucket in an outstretched arm?" She is right, if the only problem is to carry a given load, the way she does it is by far the most economical and direct. The bucket load shoots right down from her head through the torso and the feet and is from there sucked into the center of the earth. But it is obvious that you can't build a building consisting only of columns. The bucket in the outstretched arm gives a chance to occupy the space of the load with something else beside the load carrying member. So with our habit of living on top of each other it is necessary to work out a combination whereby loads can be transferred horizontally to vertical units of support.

Purpose of Framing

It might well be said that engineers ought to once and for all establish the most economical and serviceable method of framing, and then let the architects wrap themselves around it as best they can. Maybe it is that simple, but unfortunately this miraculous all-embracing framing system has not yet been found. The variations in space arrangement, location of stairs and elevators, width of building, local materials and construction methods, labor union restrictions, development of new materials, and a host of other factors make it necessary to give the buildings tailor-made, rather than ready-to-wear framing. So, willy nilly, we have to consider various framing methods. Before considering specific systems I should like to present some framing tools that often come in handy, regardless of the basic construction method employed.

Framing Tools

Building upon the basic thoughts previously outlined, it is interesting to consider some of the framing tools that present themselves in overcoming framing obstacles. Playing with these tools may serve to loosen the rigid grip of conventions. (While the outlines shown indicate concrete members, the same principles hold for steel framing, particularly so where welded connections are used.) After a consideration of these framing tools the main structural frame will be considered.

Fig. 8.

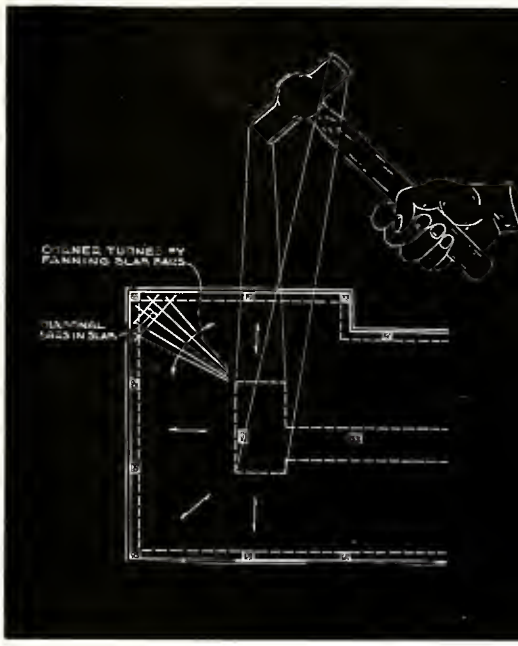
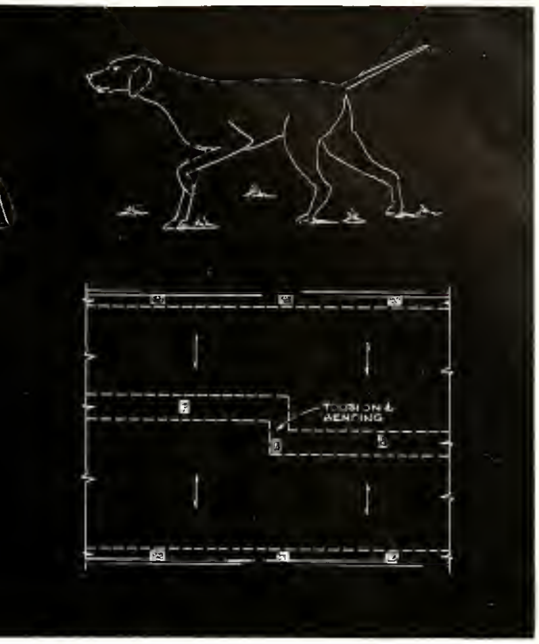


Fig. 9.



The saddle framing shown in Fig. 5 is self-explanatory. In the lower right-hand corner of this figure is shown a conventional way of framing for openings. Usually columns are placed around the opening or cross-beams clutter the landscape. The direct way is to run around the opening as fast and directly as possible. It is not necessary to arrange the columns symmetrically. Unequal loading can be resisted by the columns in bending. All columns have a certain capacity for bending without increasing their size, as determined by vertical loads. Eccentric loading, therefore, can for that reason be resisted at no expense up to this capacity, and beyond the capacity at a relatively small expense by just adding some extra reinforcement.

Tuning Fork
Fig. 6

This corresponds roughly to holding two buckets rather than one as shown in Fig. 3. The sideways bending is roughly balanced and the forward bending is prevented by a beam grabbing you in your neck. A tuning fork framing is particularly handy in a three-bedroom wing.

Tuning Fork and Saddle
Fig. 7

This shows a combination of saddle and tuning fork which sometimes comes in handy at stair openings.

Hammer Beam
Figs. 8A, 8

We have hammered out many a rough spot with this very handy tool. The hammer head very often covers the area of corridors or closets. Not only, therefore, does it provide more concrete where the load concentrations indicate, but it also saves the height of many small partitions. The fanning of the bars around the corners and diagonal corner bars has proven to be a very efficient means of utilizing the stiffness of the slab in the corners where, on account of the short spans, they act as diagonal beams within the slab.

Dog Legs
Fig. 9

A very simple arrangement for offsetting the main line of framing without adding cross-beams or extra columns. This arrangement is just as serviceable structurally

as a bent leg is to a dog.

Yokes
Fig. 10

Sometimes the framing in general may lend itself to a flat slab throughout, except for some tight spots. Here a yoke may come in very handy so that the general framing can remain and the extra burden can be carried by isolated yokes.

Island
Fig. 11

This arrangement is similar to the hammer beam one with the exception that there are four columns rather than one to hold up the hammer head. This arrangement may not fit in very often but we have sometimes used it to good advantage.

Scissor Stairs
Fig. 12

Breaking the monotony of looking down upon things, I'd like to show you a handy little trick in the framing of scissor stairs. These stairs must, according to New York City Code, be separated by fire walls and must in themselves provide fire protection. We usually build them with an eight inch reinforced concrete bearing wall in between. In this wall we leave a hole where the stair slabs intersect. These stair slabs are always placed after the floors have been poured. When these stair slabs are poured a double cantilever beam is created within the two stair slabs at the intersection. The spans are, therefore, cut in half and the moments are less than one-quarter compared to the full span from floor to floor. Another advantage is that the stair slabs can be poured without having to provide recesses in the concrete walls. These recesses are very costly to form and also complicate the wall reinforcement and the pouring operation.

Cores
Fig. 13

We have found that very often it is more practical and economical to frame the cores with all their openings and complications as flat slabs with reinforcing bands where they'll do the most good. We don't follow any set formulas but establish the general flow of stresses and reinforce accordingly.

Depressed Entrance Slabs
Fig.14.

The framing shown here is rather obvious but very often the simplicity of just bending the slab to follow the contours and design the construction as a bent slab is overlooked.

In Fig. 15 some examples are shown to illustrate how various methods may combine.

Fig. 10.

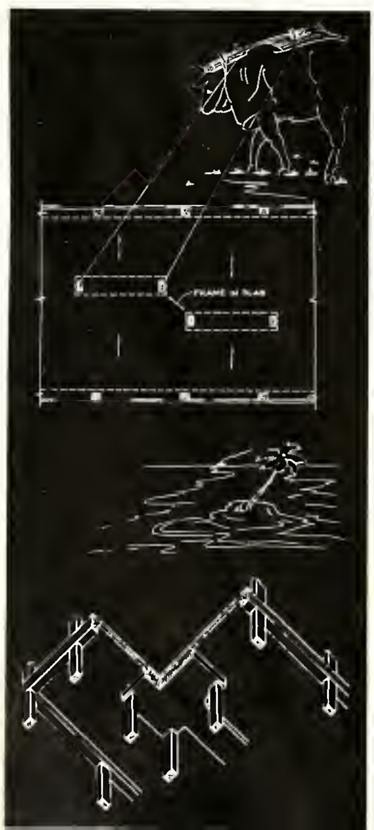


Fig. 13.

Fig. 12.

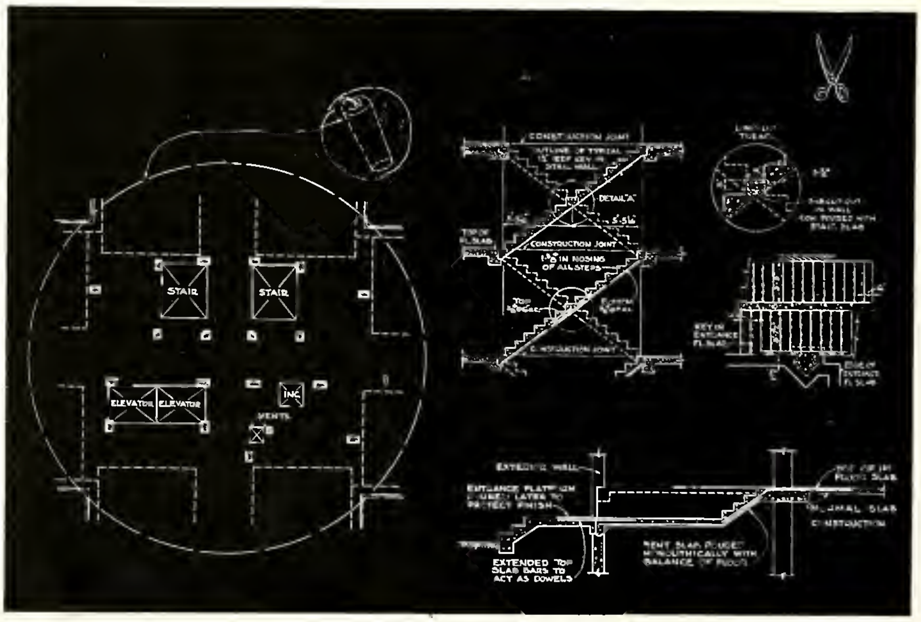


Fig. 14.

Fig. 11.

Tuning Fork

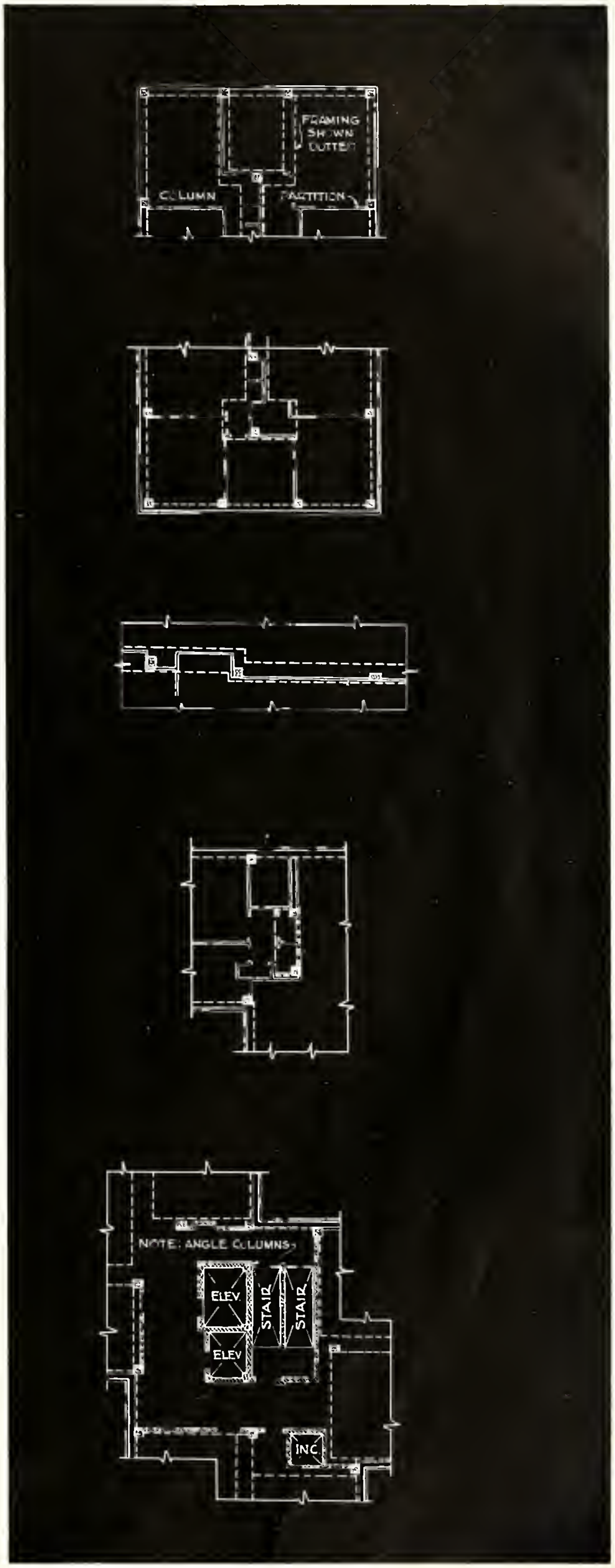
Hammer Beam

Dog Leg

Fig. 15.

Yake

Core



CHAPTER 2: Framing—Concrete

Framing Systems

After this review of solutions to localized problems, we enter upon the important field of the general framing systems.

In the selection of a proper framing system, one of the most important elements to consider is the type of ceiling that will be acceptable, not only from an appearance standpoint, but also from the maintenance angle. The trend is definitely away from plastered ceilings. Exposed concrete is becoming acceptable. In the field of low-cost housing, many imperfections are permitted, such as small fins and pitted surfaces. It is hard to avoid a certain amount of pitting because air bubbles get entrapped between the form and the concrete. However, in better class apartment houses, more attention is usually paid to the appearance of the ceilings so that all fins are rubbed off, the air holes sparkled, and a very careful paint job applied. When plywood forms are used, it is easier to get smooth ceilings than with steel forms. Steel formed ceilings have a tendency to become wavy and the fins at the joints are quite pronounced. However, even with steel forms, a ceiling can be obtained that is, in my opinion, just as satisfactory as a plastered surface. The most satisfactory paint application seems to be three coats of lead and oil with a flat finish.

An unplastered concrete ceiling is ideal from a maintenance standpoint. No plaster cracks, no scaling of plaster. If water is spilled on a floor above, it just shows as a damp spot which will dry out without requiring maintenance. On a plastered ceiling, this is not the case. Plaster will spall and crack and during the years a great amount of constant plaster repair is required.

Before jumping too quickly to a decision about what type of ceiling to adopt, some thought must be given to the reactions of the labor unions. I believe that, at present, unplastered concrete ceilings are acceptable from a union standpoint throughout the country. But there was a time, in some localities, when the plastering unions would not plaster the walls unless they could also plaster the ceilings.

One ceiling that might be considered in this connection is to cover the concrete surface with a thin layer of painter's sparkle. I know of one apartment house operator that swears by a ceiling of this kind. He can accept a rougher form finish and it looks as good as plaster. It seems to have been standing up very well during the years, but here again the union situation is rather confused.

If you must plaster, then a lightweight aggregate of some kind for the floor slab should be considered. Many people have great hesitancy about plastering on solid concrete surfaces. What we have been doing for years is to paint the forms with a cement killing application. When the forms are removed, the surfaces are then brushed with wire brushes to remove the dead cement and expose the aggregates so that a mechanical bond is obtained. By use of bond plaster, and plenty of elbow grease, we have a satisfactory finish.

With plastered ceilings, various systems using filler blocks that give good bond for the plaster should also be considered.

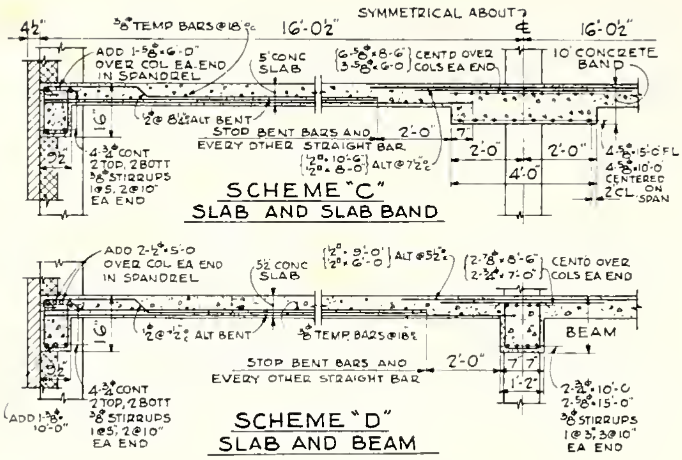
It will be seen then, that the type of ceiling has a very fundamental effect on the selection of a framing system. On projects of any size, I would recommend building test panels that can be used for experimentation to obtain the result desired. Another way to experiment with a ceiling finish is to try out various types of paints and finishing methods on the basement ceiling. By the time the first floor ceilings are ready to be finished, enough information has then been gained to permit the adoption of the most economical and practical procedure.

To my knowledge, acoustic ceilings have not yet entered the apartment house field to a great extent. However, it would be well to be on the alert for an inexpensive acoustic ceiling that would solve the problem from all angles. I don't believe that it is here yet, but I do believe that it won't be long until it will arrive on the scene.

Among the outstanding framing systems, in our opinion, is the slab-band construction which was originally adopted by us for the Vladeck Housing Project in New York City. In this particular project, as in many others, we considered using beam and slab construction. Using steel beams and a concrete slab is always tempting. It did seem unnecessary, however, to use two different materials, each of which stands out as a separate entity. It seemed better to use a single material such as concrete. When concrete beams were introduced into our thinking, it was only natural to maintain many of the concepts of steel beam construction—but is it necessary?

What we really wanted in this project was flat slab construction, and therefore the slab and beam idea was abandoned. It has often occurred to us that engineers are not fully aware of the advantages that can be gained by determining just what the economical distribution of concrete is, instead of concentrating on each of the two elements, slab and beams. Why couldn't we have a flat slab with the beams incorporated into the slab, or at least have very shallow beams which to all intents and purposes would be innocuous.

There are many factors involved in the analysis of proper concrete distribution,



QUANTITIES ARE BASED ON 1'-0" WIDE × 32'-1" LONG STRIP

QUANTITY COMPARISONS			
ITEM		SCHEME "C"	SCHEME "D"
FORMS	BEAM OR SLAB BAND SIDES	5.33 SQ FT	6.16 SQ FT
	SOFFITS	5.58 SQ FT (WIDE TYPE)	2.75 SQ FT (NARROW TYPE)
	SLAB	26.50 SQ FT	29.33 SQ FT
CONCRETE		.61 CU YDS	.63 CU. YDS
REINFORCING STEEL		71.5 lbs	75.3 lbs.

COLUMN SPACING 15'-0" OC FOR REINFORCING SHOWN

COMPARISON STUDY
SLAB AND SLAB BAND
VERSUS
SLAB AND BEAM

Fig. 16.

including the relative construction costs of the various materials, standard sizes of plywood and lumber, methods of form construction, etc. The rigidity of framing members also plays its part. No attempt will be made here to retrace the various steps that have led this office, in many cases, to adopt the shape known as slab-bands, and the selection of various widths and depths of these slab-bands. However, by presenting one example (Fig. 16), the general approach is, I believe, well illustrated. This study is based on a low-cost housing unit. The live load is 40 pounds per sq. ft. The selected distribution of the concrete is a result of the following factors:

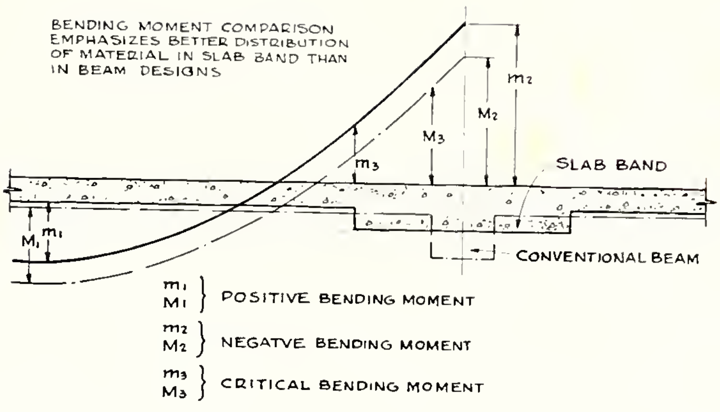
Design Basis and Benefits

1. The slab-band is considered as a haunch of the slab, giving greater stiffness of the slab at the haunched end. Thereby both the initial fixed moments (in a Hardy-Cross analysis) and also the carry-over factors, tend to "*draw*" the negative moments towards the slab-band.

2. The *critical* negative moments are at the edge of the slab-band, and although the maximum negative moment is increased as compared with a narrow-beam design, the moment that determines the negative reinforcement in the haunched slab is smaller. For illustration of the above points, see Fig. 17.

3. As a consequence of the more efficient distribution of concrete, less concrete is required. The clear span between deep beams is greater than the span between slab bands. The total reinforcement of the slabs is, therefore, obviously reduced and this reduction is so material that it far outweighs the increase in reinforcing steel in the slab-band as compared with a deep beam.

4. The wide soffit of the slab-band is more economical to form, and the over-all cost of formwork is reduced.



SMALL LETTERS REPRESENT BENDING M OF SLAB BAND

CAPITAL LETTERS REPRESENT BENDING M OF CONVENTIONAL BEAM

Fig. 17.

5. In housing, it is quite usual to arrange the closets at the center of the wings and, thus, where the slab-band occurs. The saving of closet partitions then becomes a considerable item.

6. Although the point that follows should be checked with local building codes, it seems obvious that a slab-band needs no more fire protection than a slab, except at the edges. It is the spalling of the corners that has dictated the greater fire protection of narrow beams and columns. Requirements for fireproof buildings are based on fire ratings. The fire ratings are the same for both slabs and beams. In fact, the slab-bands, except at the edges, are in a no different category in their function than a column band in a flat slab design. Only slab fire protection of reinforcement is required in such column bands.

Since prices fluctuate with time and location, no attempt has been made to arrive at a cost comparison. With all the material units given it becomes an easy matter to make a comparison that will be in accordance with local cost factors.

Other Benefits

In addition to the benefits mentioned, there are other factors to consider. The columns can be placed anywhere within the confines of the band to suit the partition layout. The columns won't be in a center line straight jacket, but can be given free play from extreme left to extreme right. The eccentricity is easily absorbed as bending in the columns, usually without increase of size or reinforcement in the columns, since these have an inherent capacity for bending.

Those of you that may be faced with the problem of actually designing a slab-band may like to know what methods we have found most convenient. Three methods are shown for a rather typical case.

The fixed end moments and carry-over factors are readily found by the following charts (Figs. 34–36). The method of finding the coefficients used is shown on these charts by heavy arrows for one example. (Figs. 34–36 and Charts, Figs. 37–40, are shown on pages 195–199.)

The effect of the outside columns on the rigidity of the slab-band is influenced by the torsional deformation of the spandrel beams. This element can be readily evaluated by an experienced designer. In the examples a .25 stiffness factor was assigned to the spandrels.

Smooth Slabs without Column Heads

This is an adaptation of flat slab design, only that column heads and dropped panels have been eliminated. This system has gained a great deal of popularity.

The great simplicity of completely flat surfaces is very tempting. It is the architects' and mechanical engineers' dream. But I am afraid the owner pays a premium, varying in amount with the specific framing condition. It is obvious that stresses and concrete quantities are not in a proper relation. A good part of the thick slab is comfortably asleep. Not only does it do no work, but it puts extra load of useless concrete on the whole frame and the foundations. A fairly regular column spacing is rather important if a flat ceiling system is considered. Modern design analyses can overcome design difficulties, but difficult methods usually result in increased costs, particularly in the placing of reinforcement.

An example of a flat ceiling design is given on the following drawing. The design is in accord with the American Concrete Institute Code (Fig. 18).

With a system of this kind, a word of caution is in order. There is a tremendous concentration of stress around the columns. Only comparatively few buildings have been erected with this type, and it is yet too early to say with finality that this concentration of stress without addition of slab thickness may not show signs of distress as years go by. Structures have a way of expressing themselves and it is just possible that the small area around the columns that is called upon to work overtime may eventually speak up.

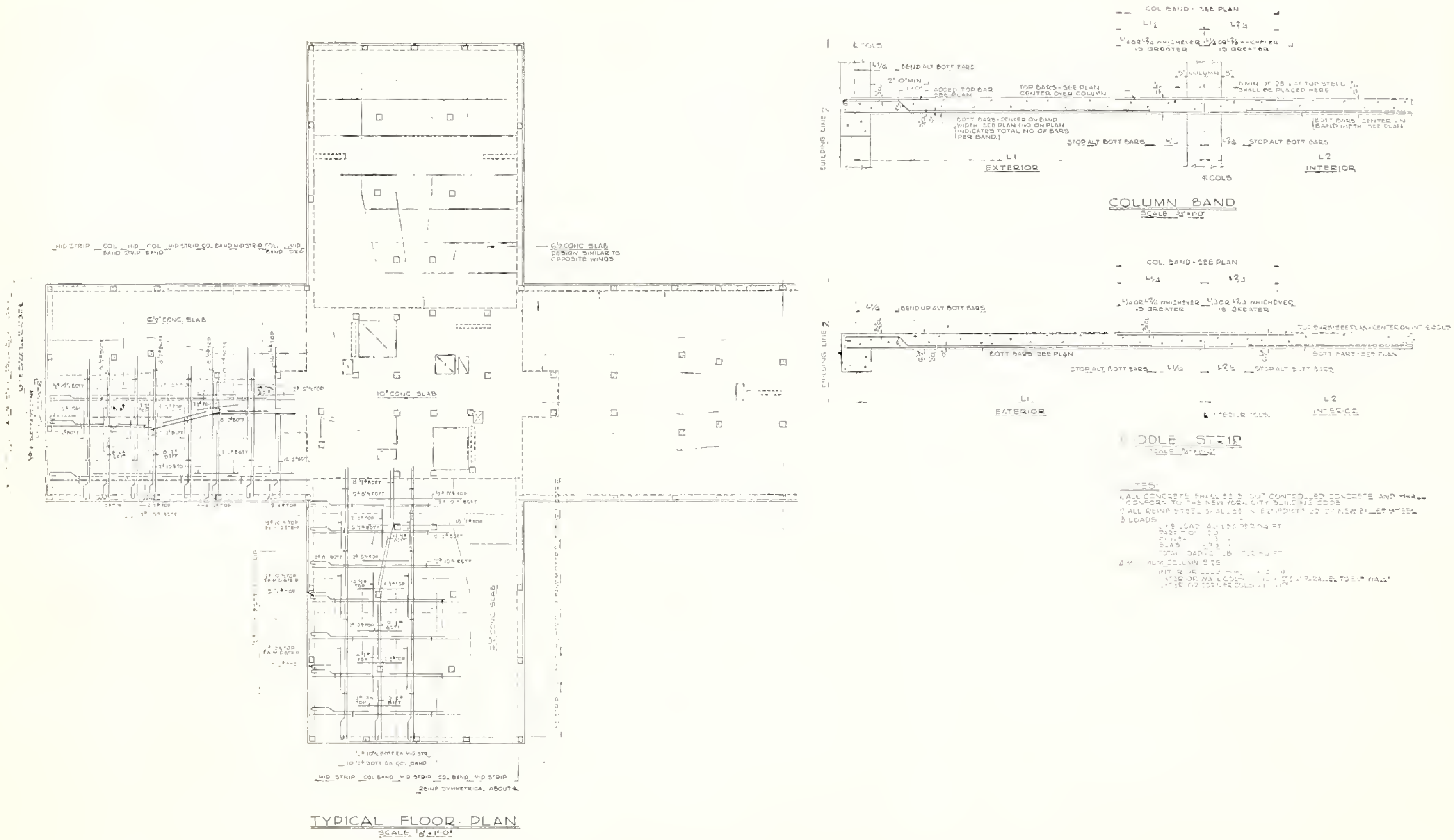
Another thing, if you want membranes in your bathroom floor, we wouldn't advise you to use this system. Depressions in smooth slabs are annoying and costly. So, check first on your finishes.

There is one peculiar quirk in the design of this system: Many codes will consider it a flat slab. The New York City Code for instance, has this definition: the total thickness, t, in inches, of slabs without dropped panels, shall be at least

$$t = \left\{1 - \frac{1.44c}{L}\right\} L \sqrt{w'} + 1\tfrac{1}{2}$$

wherein c = Diameter of column in feet
L = Span in feet
w' = Total life and dead load in lbs. per sq. ft.

Ordinary flat slabs are designed by empirical formulas. They are usually selected for heavy loads where unequal loading throws great bending into the columns. For that reason, the slab thickness and the minimum size of the columns are out of line for an apartment house loading condition.



TYPICAL FLOOR PLAN
10" CONC SLAB
6½" CONC SLAB
6½" CONC SLAB DESIGN SIMILAR TO OPPOSITE WINGS
REINF SYMMETRICAL ABOUT ℄
COLUMN BAND
COL BAND - SEE PLAN
EXTERIOR
INTERIOR
BEND ALT BOTT BARS
BEND UP ALT BOTT BARS
BOTT BARS SEE PLAN
STOP ALT BOTT BARS
BUILDING LINE

Fig. 18.

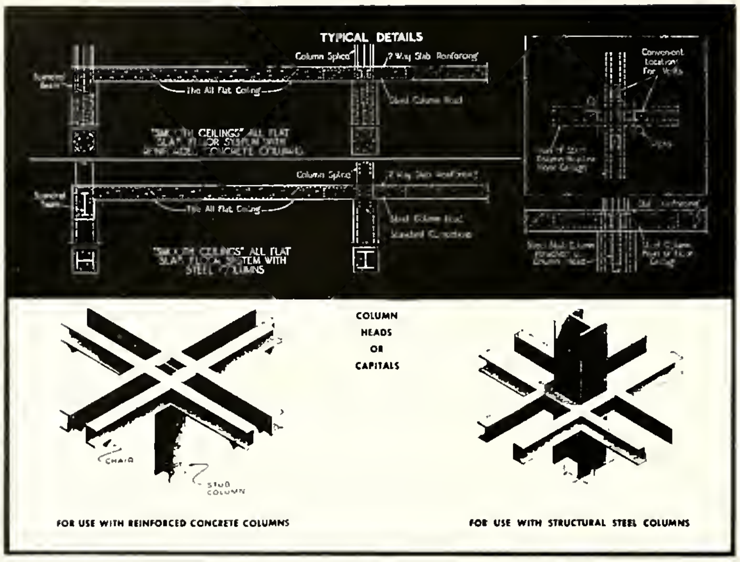


Fig. 19.

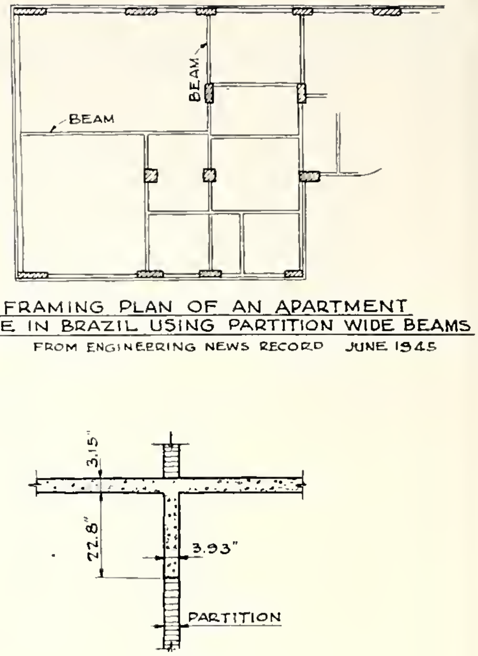


Fig. 20.

So you go to the Building Department and say that you don't want to use empirical formulas. You are going to make an exact analysis. "I am going to analyze the column strips and the columns as rigid frames, and if the stresses are within the Code, what are you worrying about?" "All right," says the Code, "Then your column strip is a beam, these beams must have 1½" fireproofing of reinforcement."

To cut a long long story short, you had better find out what your Code is going to do about it.

Smooth Slabs with Steel Column Heads

If you must have a smooth ceiling throughout, it may be good insurance for the next few years to relieve the column head concrete by adding a channel grid. You will have to pay a small royalty, if you do, because this system is patented by Wheeler. Here is the way his system works:

Smooth Ceilings

Steel column heads are placed within the confines of the slab to produce all flat ceilings and still resist the great stress concentration around the columns. It can be used both in connection with a solid concrete slab and also with structural fillers to reduce the loads. In Fig. 19 are shown some typical details that have been taken right out of a "Smooth Ceiling" catalog.

Narrow Beam and Slab Construction

You must have gathered by this time that we consider the ordinary 12" wide (not even 11½" to fit form lumber) and relatively deep beams, to be passe for apartment house construction. But there is one type of construction that may be of interest, although we can't work up too great an enthusiasm over it. This is the partition wide beam occupying the four inch space between apartments (Fig. 20).

It isn't very economical in the United States because there is too much formwork to produce a measly four inch sliver of concrete. In South America, materials far outweigh labor, but here it is the other way around.

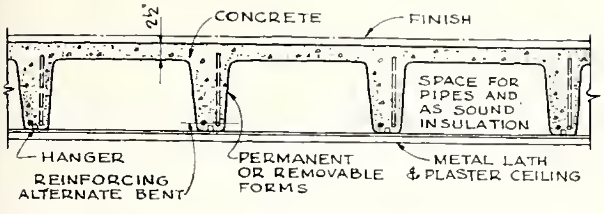
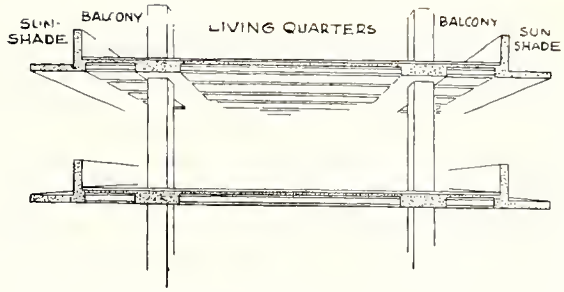


Fig. 21.



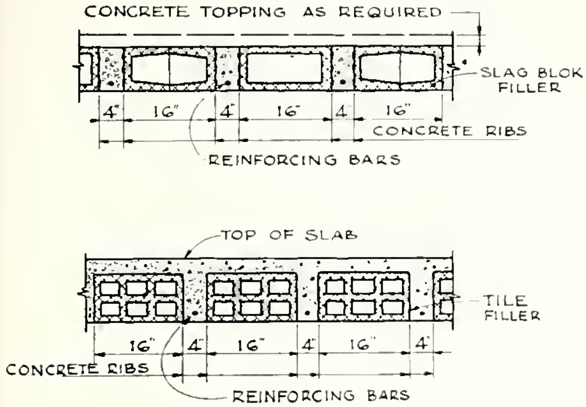


Fig. 22.

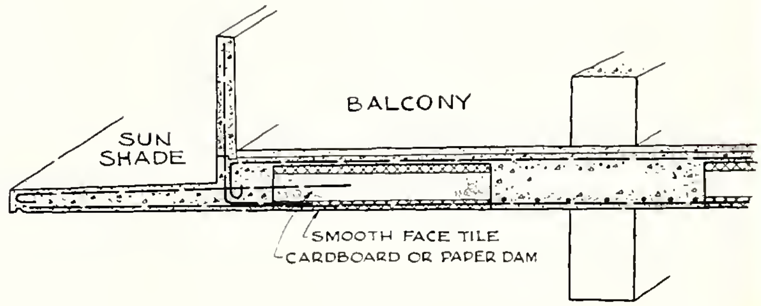


Fig. 23.

Filler Systems

There is no end to the invention of filler systems to reduce the dead loads in construction. But in the relatively short spans that apartment house construction presents, they have not proven economical. One of their greatest handicaps is that owners universally have required plastered ceilings with this type. With the use of acoustical ceilings becoming popular, it may be possible to use some of these systems economically.

Tinpan
Fig. 21

The well known tinpan construction. This type is normally produced by removable steel pans or forms. In New York City the requirements for first class fireproof construction is a minimum of 2½ inches of concrete and a plastered ceiling. We have used a great deal of this type of construction without a plastered ceiling and have had very good results. Noise transmission through only two and one-half inches of concrete should be considered and the local requirements for fire protection ascertained. It is easy enough to correct both these deficiencies by a fireproof floor fill, but this entails additional expense that may outweigh the elimination of plaster. Exposed ribs require more careful workmanship, therefore, we don't believe that the net result in most cases will be one of economy.

Tile Fillers
Fig. 22

A type that is also well known, here again it is possible to eliminate the use of plaster. This can be done without the two handicaps mentioned under "tinpan" construction, but it is questionable whether the tenants would be satisfied with the rather crude looking ceiling that results. Paints are being developed that have great covering qualities and it may be that before long such paints will produce an acceptable ceiling without plaster.

A rather interesting adaptation of this system, taken from the design of a hotel, El Panama, in Panama City, by Edward D. Stone Associates, architects. As seen in Fig. 23, it is a one-way tile design with columns so arranged that the band between the columns falls within the thickness of the slab. Although used in the design of a

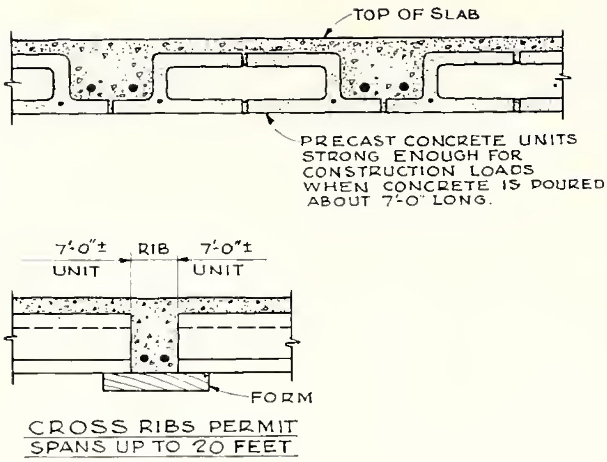
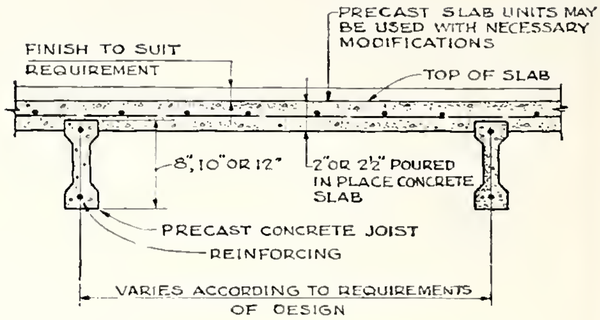


Fig. 24.



COURTESY OF PORTLAND CEMENT ASSOCIATION

Fig. 26.

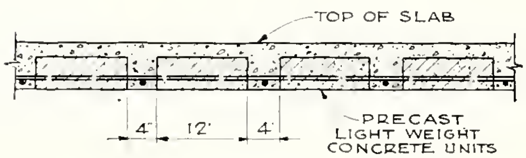


Fig. 25.

hotel it can, of course, be used to equal advantage in apartment houses.

Precast Concrete Fillers
Fig. 24

A system developed by Mr. B. Myers and myself. The manufacture of the precast units was all geared for machine production but was very rudely interrupted by the depression. Since then I have been too busy with other things to follow it up. I can't say that I have too much faith in it, but one can never know in these days of expensive formwork. The construction can be used for short spans of one unit length or for longer spans with a combination of units through the pouring of transverse ribs.

Solid Lightweight Concrete Fillers
Fig. 25

Solid filler units may be made of lightweight concrete. The success of such a system is merely a question of the cost of the filler unit. So far we have found that it is still not competitive. It is, however, still in the embryonic stage and may bear watching.

Precast Concrete Systems

The technique of handling large and heavy sections has in recent years become highly developed. The way big cranes can dangle tremendous loads in the air, back up, step sideways and go forward and then deposit the load with great accuracy is something to marvel at. The interplay between man and machine has all the elements of beautiful art. It is only recently that the house building industry has begun to feel the impact of this art. That it will do so to a greater and greater extent seems unquestionable, particularly so with the sharp upturn in field labor cost that has just been experienced. It is important, therefore, to be fully conscious of the possibilities that are here right now for handling big pieces economically, and also to have our eyes and ears open for future possibilities.

Concrete Joists
Fig. 26

Details are shown in Fig. 26. It is questionable whether this type of construction is economical for construction of upper floors, but if an exposed joist ceiling is not objectionable it may be worth while to make a cost comparison.

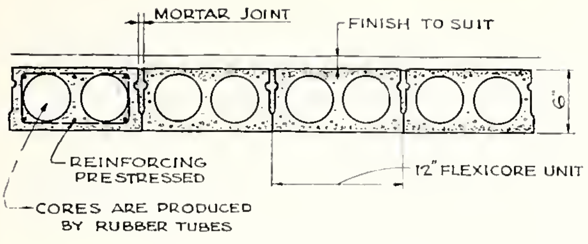


Fig. 27.

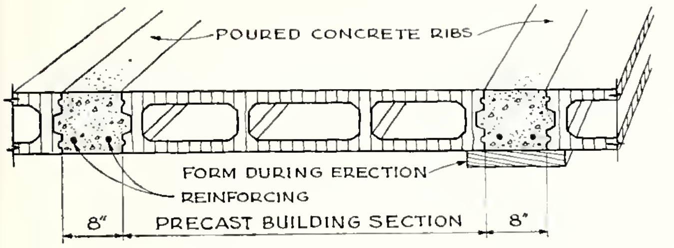


Fig. 28.

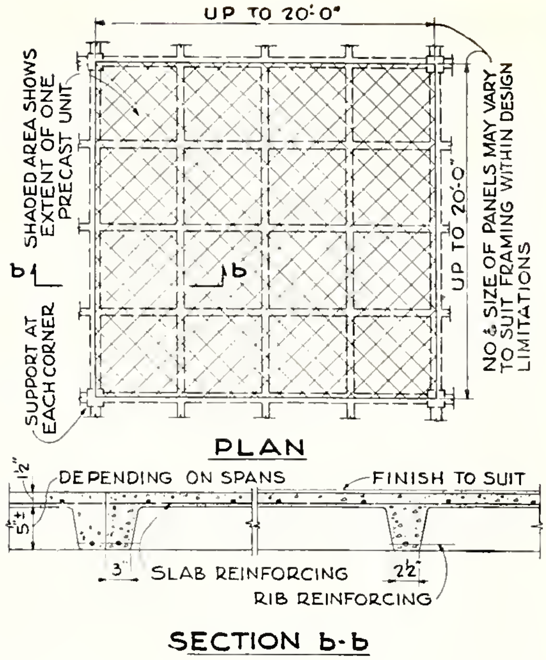


Fig. 29.

Reinforced Hollow-cast Concrete Slab
Fig. 27

This construction is comparatively new but is being pushed very vigorously. It provides for an upper surface ready for the finished flooring and the lower surface ready to be painted. It can span up to 20′ and it has in it many elements that are very attractive. A major disadvantage is that it does not have a first class fireproof rating, but eventually this may be overcome by using lightweight concrete with great fire resistance. We consider this development as a very promising one and have already considered its use for an apartment house development in the Metropolitan area. It is obvious that the use of a plant manufactured flexicore unit is restricted to a comparatively limited radius from the plant, but we understand that these units can also be field manufactured. Undoubtedly numerous plants will soon cover the country.

Precast Building Sections
Fig. 28

The unit here is principally developed as a precast wall unit. However, it seems also to have good possibilities for floor construction, particularly when the same units are also used for the walls, and therefore heavy construction is possible. A description of this unit will be found in more detail on page 212 in connection with its use for walls.

Waffle Panel
Fig. 29

This is a very intriguing floor panel that has been developed by Captain Praeger of Madigan-Hyland Co. Figure 29, reproduced through his courtesy, shows a typical detail worked out for a housing project, as built by the George A. Fuller Co. The ribbed floor plates are poured into concrete moulds. Excess water is removed by vacuum pads so that the plates can be removed a very short time after the concrete is set. In order to minimize the stresses during removal, they are lifted off the forms by trucks and placed in position by cranes. Vacuum lifts are not used in the actual placing. The supports shown in Fig. 29 are concrete piers, or pipe columns located at the corners. The economy of a system of this kind is intimately tied up with large projects which can amortize the cost of equipment in production and

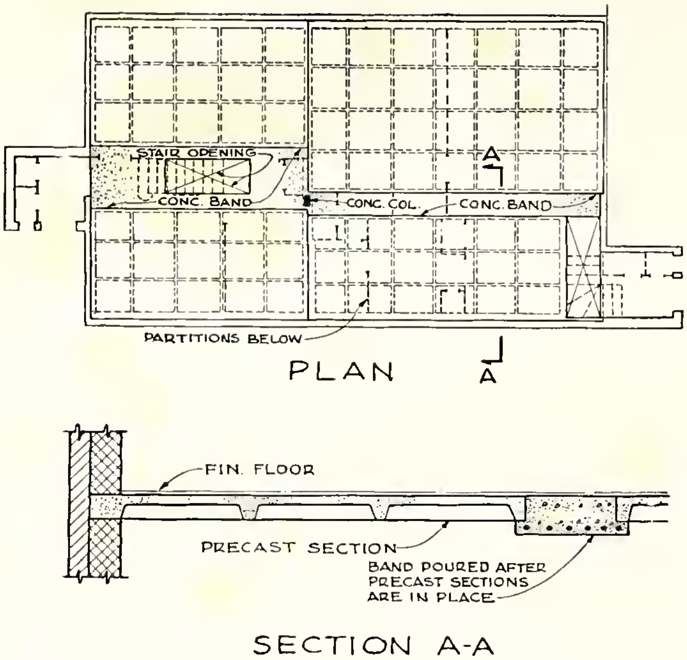


Fig. 30.

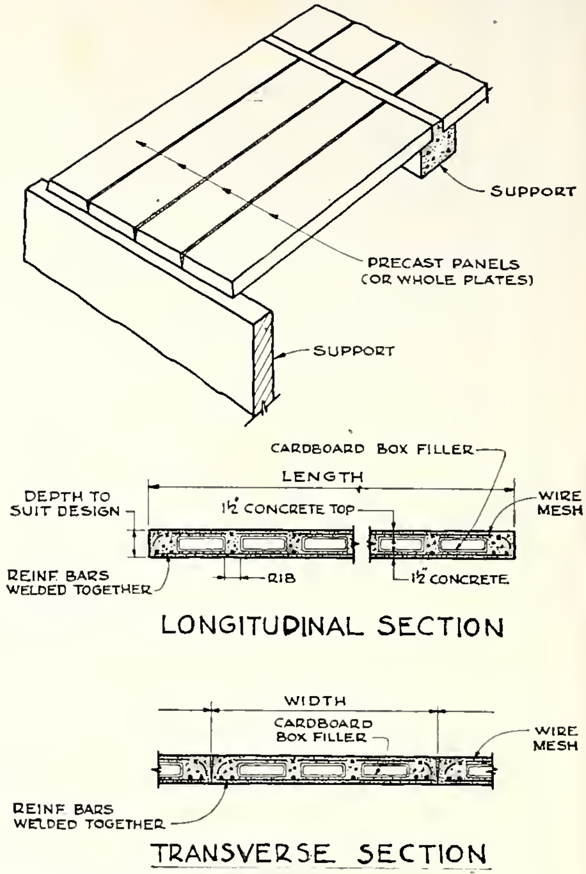


Fig. 31.

setting of the plates. This construction is fire-resistant and non-inflammable but is not fully fireproof. The sound transmission through the 1½″ concrete is a factor to be considered, although reports so far seem to indicate that the noise problem is not too serious. Figure 30 shows a modified support suggested by us for greater ease in framing and placing.

Severud Panels

Figure 31 shows a system that we have developed. The sketch should be self-explanatory. The various stages in the production of a floor panel have been indicated. The advantage of a system of this kind, above the one just mentioned, is that it does not require concrete molds. Pouring directly on a concrete slab which has been prepared with form oil and lacquer provides for easy removal of the poured section without special equipment. Other obvious advantages are that a smooth ceiling is provided and that the section is far more sound insulating. By the time you read this, we hope that the method has been fully tried, and successfully so.

There is, of course, no reason why this same panel could not be used for exterior or interior walls.

Partitions

The arrangement between columns and partitions should vary according to the degree of finish that is desired. In highclass apartments it is obvious that a painted concrete column would not be tolerated, at least not at present. However, for low cost housing, there is quite a saving eliminating plaster on the columns. In Fig. 32 are shown some suggested details that would apply for low cost housing only. This sketch is included mainly to illustrate what the problems are and as just one example of how to solve them.

Angle Columns
Fig. 33

An arrangement that lends itself well to the use of angle columns in corners and at the elevator shafts. These angle columns permit a much better arrangement of furniture and thereby save a lot more space than the difference between a concrete

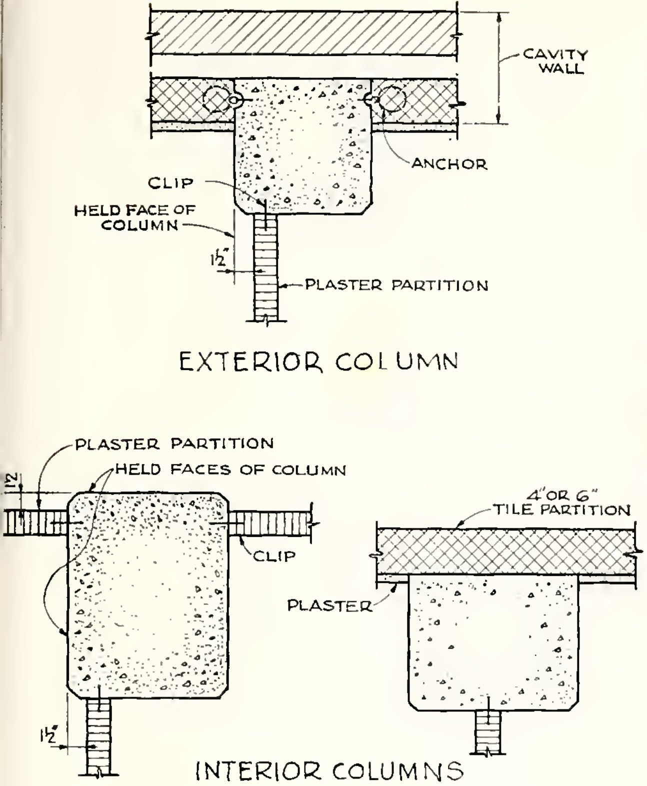
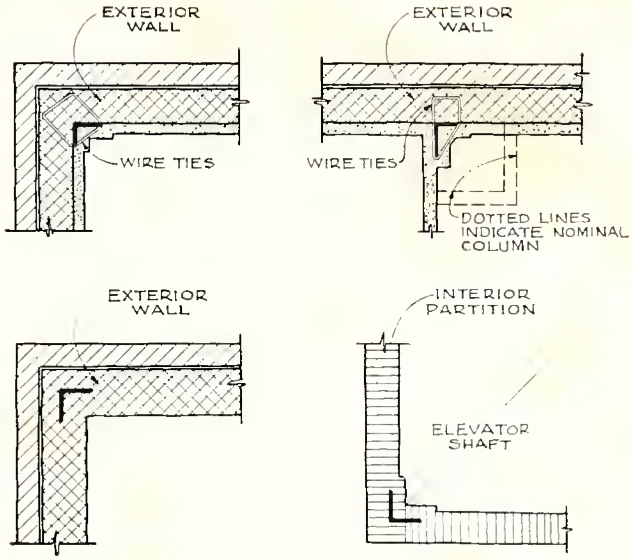


Fig. 32.



DETAILS SHOWING ANGLE COLUMNS.

READER CAN READILY VISUALIZE THE ADVANTAGES OF THESE DETAILS AS COMPARED WITH NOMINAL COLUMN CONSTRUCTION IN SOLVING MANY SPATIAL PROBLEMS.

Fig. 33.

and an angle column. It is very important, however, if angle columns are used, to organize the project so that there is no delay in waiting for the angles to be erected. It is also necessary to fit some temporary bolts in the floor slab so that these angles can be plumbed by a knee brace to the floor.

What Type Concrete

The composition of concrete has now reached a point where its characteristics can be very accurately controlled. For reinforced concrete work, ordinary gravel or stone concrete is usually the most economical. Later we'll say a few words about lightweight aggregates.

The proper strength of concrete to be selected for the design may vary somewhat with local conditions, but it can be safely stated that the following considerations furnish a good guide for apartment house construction.

A. For all types of concrete it is more economical to use a strength specification concrete with proper laboratory and field controls than to use concrete arbitrarily selected by volume. The cost of the control of concrete is, except for very small projects, always more than repaid by obtaining a good workable mix with a minimum amount of cement. By an intelligent control of concrete, a mixture is produced that is so plastic that segregation is avoided and it flows into the corners and around the reinforcement. Thus a smooth surface is produced without honeycombing so that a minimum amount of repointing of exposed concrete is required.

B. A design strength of 3,000 lbs. for the floor system usually provides for a maximum of economy in design within deflection limits and amount of reinforcement. Richer concretes tend to develop greater shrinkage stresses than are comfortable, particularly if exposed concrete is used. Shrinkage in concrete and the resultant friction against the forms are the cause of insipient cracks that may later open into objectionable defects.

C. For the upper columns, the same strength concrete should also be used, but as the loads increase, it becomes very economical to change into higher strengths. We have found that it is rather difficult to obtain better than 3,750 lb. concrete without an unreasonable amount of cement and we usually stop at this point.

D. Even for foundation work we have found that controlled concrete is economical and here we have found that a 2,500 lb. concrete is very serviceable. It gives concrete that is weather resistant and also gives a good bond value for the reinforcing bars in the footings.

E. For floors on the ground, a strength of 1,650 lbs. per sq. inch has proven very satisfactory.

Lightweight Concrete

There are various types of lightweight aggregates such as cinders, slag, diatomaceous earth, and burned shale. In reinforced concrete construction, cinders and diatomaceous earth do not give the required strength. On long spans there is also too much shrinkage, resulting not only in cracks but in deflections due to greater shrinkage of the top surfaces. Both slag concrete and burned shale have given good results. Slag aggregate is more universally available and is, therefore, cheaper, but heretofore the grading of this aggregate has not been very uniform and this is a serious handicap for the consistent production of a workable mix.

Shale aggregates are very popular within proper distances of the rather scattered plants that are in operation. These aggregates have, however, produced concrete of excellent character and high strength, with a great reduction in dead weight. We have made comparative designs that have proven that substantial economics can be achieved using aggregate of this kind.

Both slag and shale aggregates require much more attention to the proper composition of the mixture than does ordinary concrete. Also the time of mixing and even the speed of mixing must be well regulated because these lightweight concretes have a tendency to become "harsh" and unworkable. Sometimes replacing a bag of Portland Cement with a bag of Natural Cement per cubic yard of concrete increases workability remarkably.


No. G

FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK 17

Sheet No. 1

Date

Project Sample Design

Archt.

Des. By

Fig. 34.

Comm. No. 6

fs 20000 #/in²

fc 2500 #/in²

FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK 17

Project Sample Design Archt.

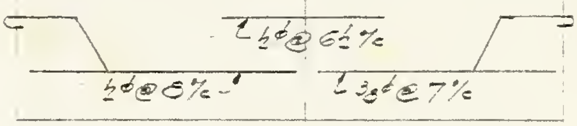
Sheet No. 2

Date July 26 1945

Des. By Bi.

$W = 53 \cdot 15 = 1045\#$ $W = 123 \cdot 13 = 1600\#$

	.75		.44	.56		.75
	-1275		-2180	-2530		-1350
	+955		-155	+195		+1010
	+75		-620	-710		-95
	-55		-30	+40		+70
-M	-300		-3005	-3005		-365
R				1005 #		600 #
					+1100	
DESIGN MOMENTS	-595	+1660	-3050		+1100	-365
STEEL AREA A_s	.10	.29	.36		.19	.06
		5" C.SL.			3" C.SL.	



TWO CYCLE METHOD

FOR PHYSICAL PROPERTIES AND
DESIGN FACTORS SEE PAGE 1

S	.75		.44	.56		.75
FIXED END MOMENTS D.L.	-1275		-2180	-1710		-910
FIXED END MOMENTS T.L.	-1890	+900 A	-3230	-2530	+660	-1350
CARRY OVER	-330	+295 B	-950	-710	+85	-95
ADDITION	-2220	+440 C	-4180	-3240	+350	-1445
DISTRIBUTION.	+1665		+415	-525		+1085
M	-555	+1635	-3765	-3765	+1095	-360
R	710 #		1135 #	1060 #		540 #

$\Delta M \cdot C \cdot S$

A) $M = M_o - \frac{M_L + M_R}{2}$

B) $M = M_{co_L} \left(\frac{1}{C_R} + S_L - 1 \right)$

C) $M = M_{co_R} \left(\frac{1}{C_L} + S_R - 1 \right)$

SLAB REINFORCEMENT AND
SIZE SAME AS ABOVE

Fig. 35.

Comm. No. G

f_s 20000 #/in²

f_c 2500 #/in²

FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK 17

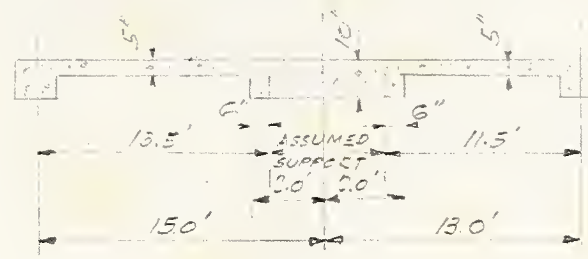
Project Sample Design Archt.

Sheet No. 3

Date July 24, 1945

Des. By F.L.

APPROXIMATE METHOD



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	-1870		-1870	-1365		-1365
	+1400		+230	-275		+1020
	-115		-700	-510		+140
	+85		+85	-105		-105
	-40		-40	+50		+50
	+30		+40	-50		-40
-M	-510		-2035	-2255		-300
R	700#		960#	875#		540#
+M		+1280			+645	
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	+1400		+429	-515		+685
	-220		-700	-340		+260
	+165		+165	-195		-195
	-80		-80	+100		+100
	+60		+85	-95		-75
-M	-545		-1960	-1960		
R	725#		935#			
+M		+1590				
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	-1260		-1260	-1365		-1365
	+945		-50	+55		+1020
	+25		-470	-510		-30
	-20		-20	+20		+20
			-1800	-1800		-355
				835#		580#
					+1010	
DESIGN MOMENTS	-545	+1590	-2255		+1010	-355
A_s	.10	.28	.39		.18	.06
		5"C.SL.			5"C.SL.	

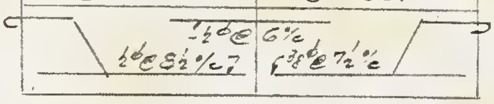
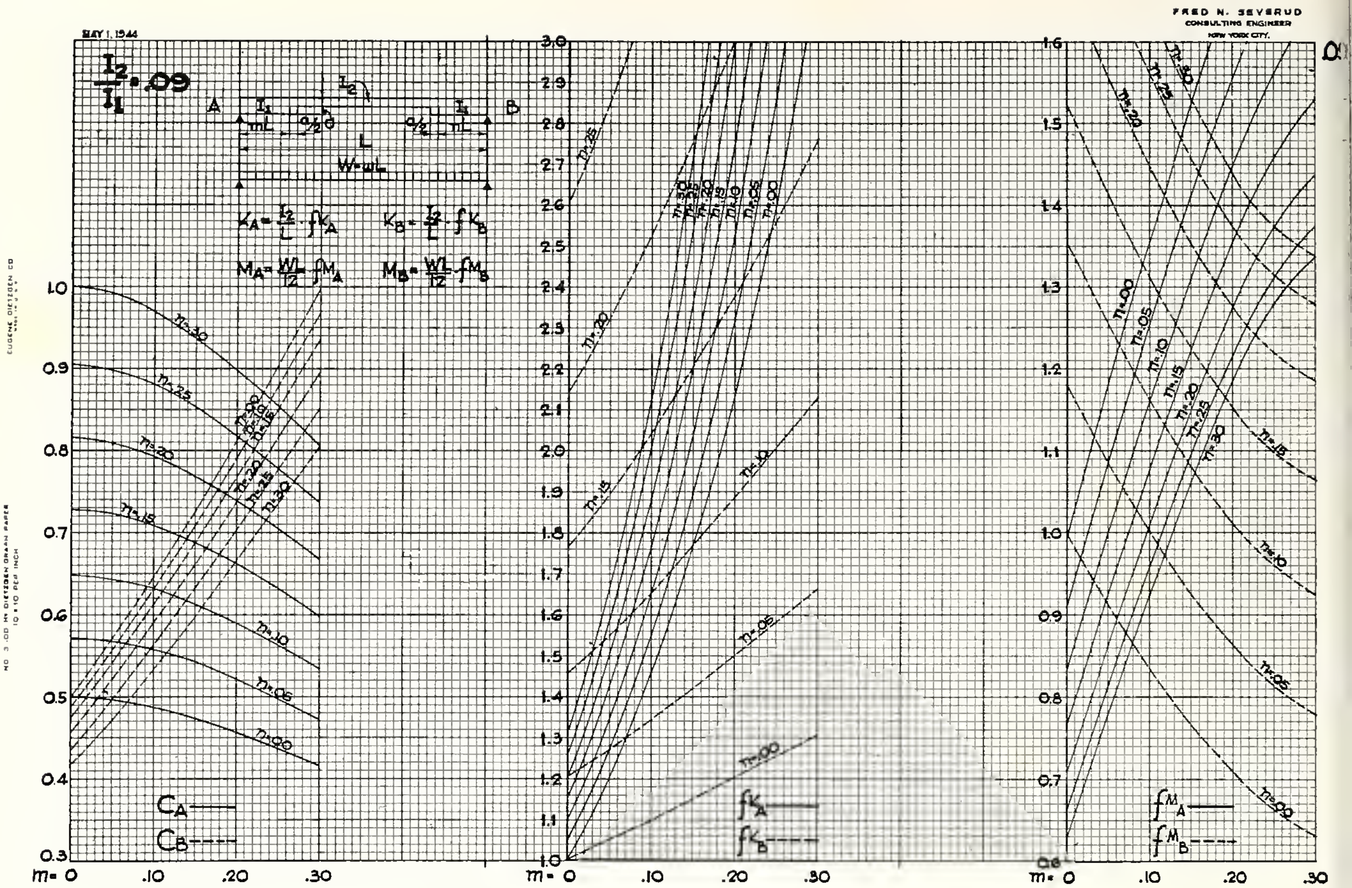


Fig. 36.


FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK CITY
MAY 1, 1944
$\frac{I_2}{I_1} = .09$
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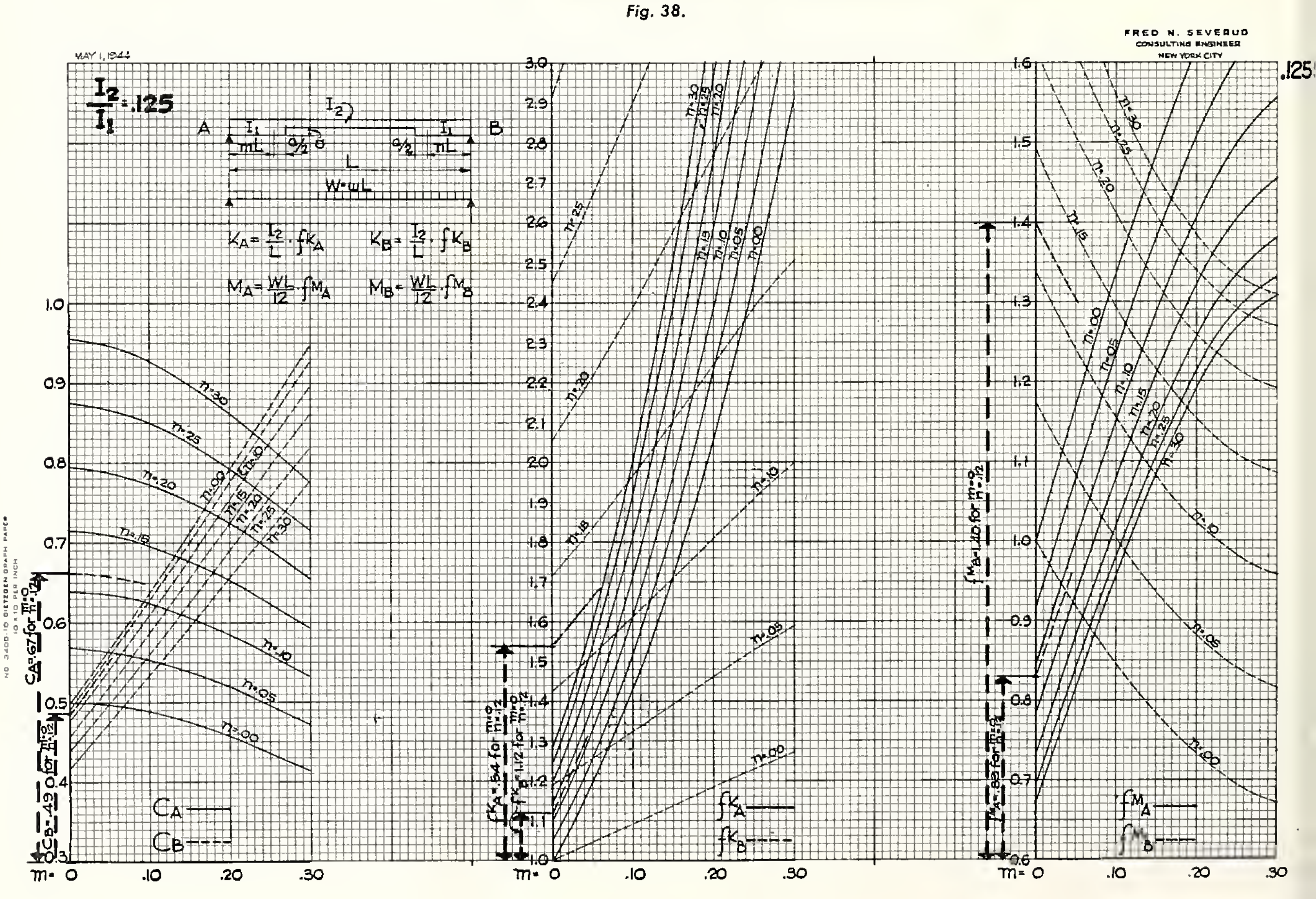
$K_B = \frac{I_2}{L} \cdot f K_B$
$M_A = \frac{WL}{12} \cdot f M_A$
$M_B = \frac{WL}{12} \cdot f M_B$
W=wL
C_A
C_B
fK_A
fK_B
fM_A
fM_B

Fig. 37.

Fig. 38.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CONSULTING ENGINEER
NEW YORK CITY
MAY 1, 1944
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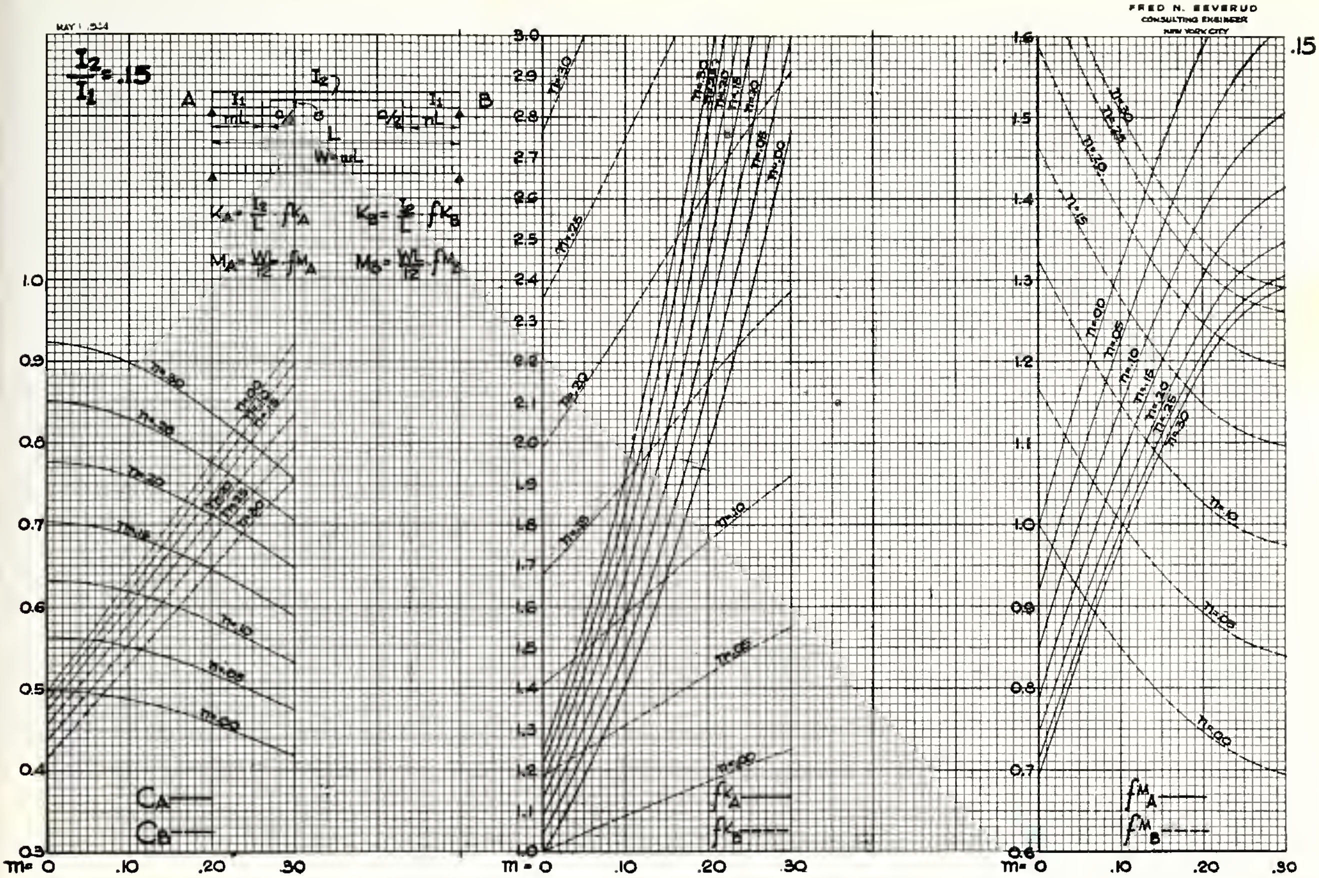
C_A
C_B
fK_A
fK_B
fM_A
fM_B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FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK CITY
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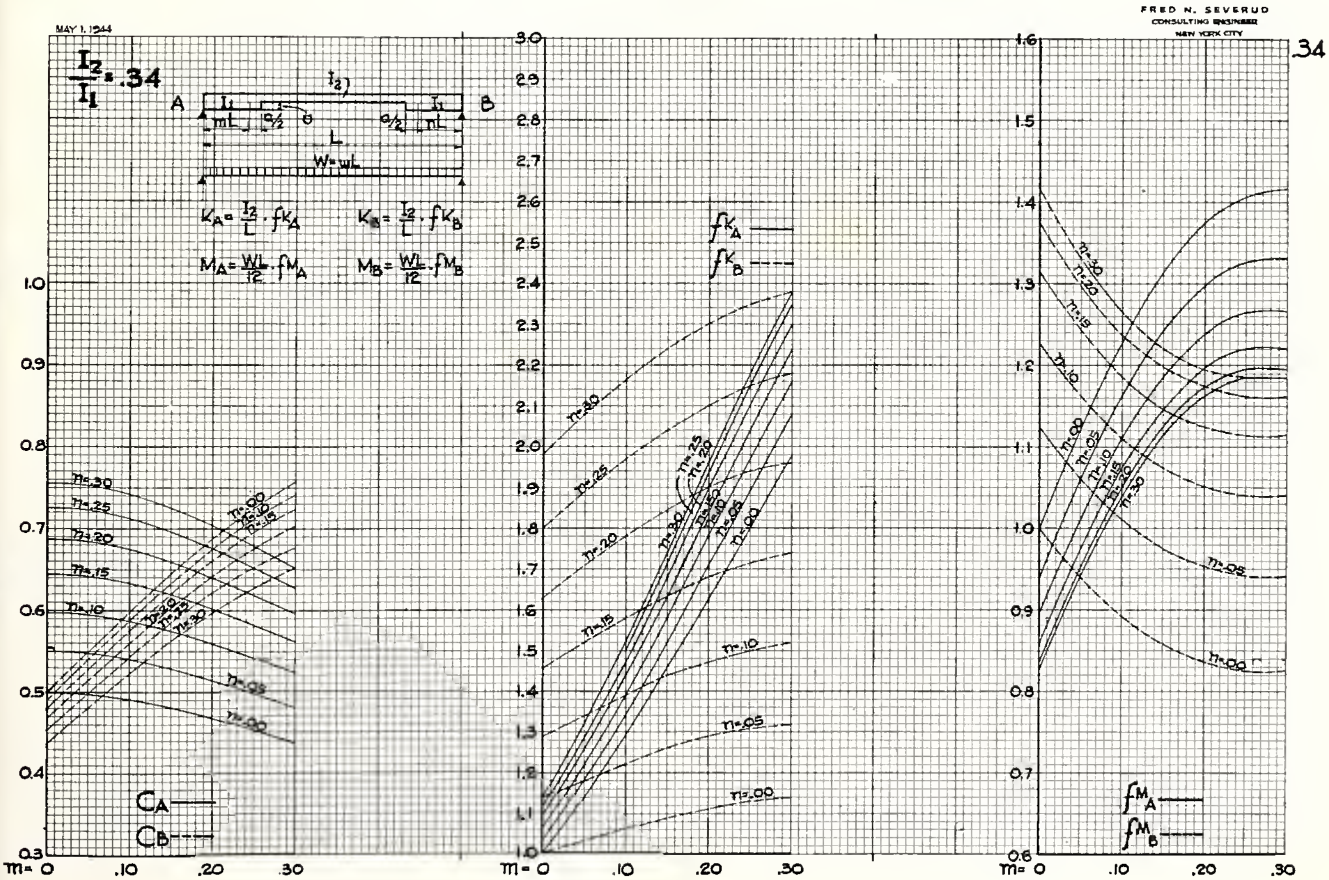
$M_B = \frac{WL}{12} \cdot fM_B$
W = wL
C_A
C_B
fK_A
fK_B
fM_A
fM_B
m = 0
.10
.20
.30
.15

Fig. 39.

Fig. 40.


MAY 1, 1944
FRED N. SEVERUD
CONSULTING ENGINEER
NEW YORK CITY
$\frac{I_2}{I_1}$ = .34
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$M_B = \frac{WL}{12} \cdot fM_B$
W = wL
C_A
C_B
fK_A
fK_B
fM_A
fM_B
m = 0
.10
.20
.30
.34

CHAPTER 3: Framing Systems—Steel

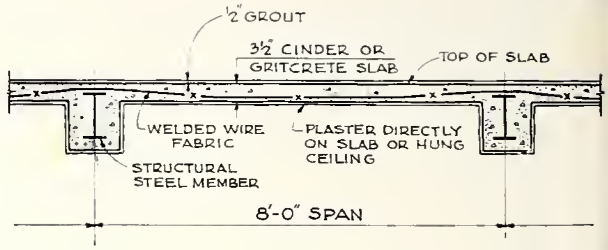


Fig. 41.

Steel Construction

When steel construction is dealt with, after concrete, it is not because we consider it less important but it is because, at present, more apartment buildings throughout the country as a whole are being built in concrete than in steel. However, many types of floor construction can be used only with a steel frame and in days of wildly fluctuating costs a steel frame of some kind should always be reviewed before a definite decision is made as to how best to hold the building up. Some of the outstanding advantages with a steel frame versus concrete may be listed as follows:

1. Less weight; therefore, cheaper foundations. Since many apartment houses are built on poor soil, this element should not be overlooked.

2. Less dependent on climatic conditions. It can progress more readily during winter time when construction costs are usually somewhat lower.

3. Where there are many offsets, such as in congested areas affected by zoning laws, a steel frame can support offset columns, with lower story height. (It should be remembered, however, that heavy steel sections such as a nominal 14" column can be used in connection with a concrete frame to support heavy loads. The consideration of isolated obstacles should, therefore, not influence the selection of the fundamental frame.)

4. Alterations can usually be made with greater facilities.

5. A greater uniformity of the quality of the materials, resulting in a safe structure with less stringent supervision.

6. Steel members in connection with concrete floors furnish a greater resistance to shrinkage forces than concrete members reinforced with steel bars. For this reason,

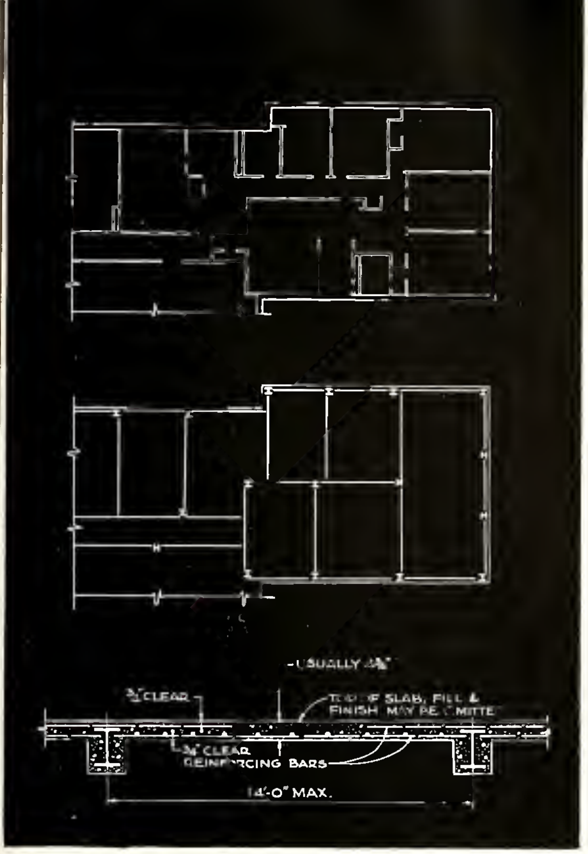


Fig. 42.

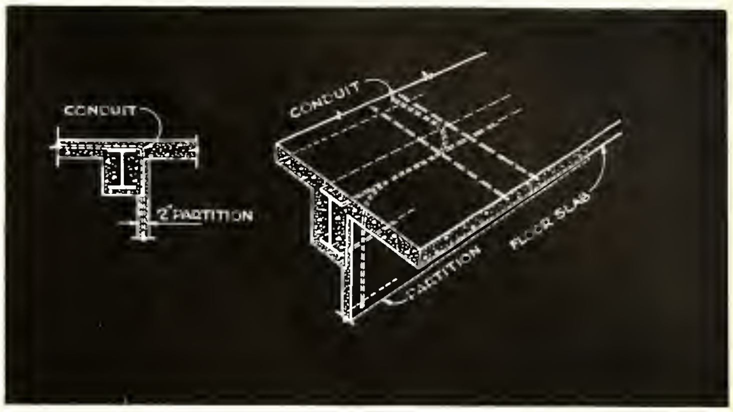


Fig. 43.

expansion joints can be located at greater distances with a steel frame and therefore the buildings may be built longer with a steel frame without expansion joints than is safe with a reinforced concrete structure.

7. A steel frame has a certain advertising value. In these days when so much South American work is built by American firms, we have found that many of these owners are willing to pay a premium for a steel frame since the dash of getting a complete skeleton overnight is very impressive.

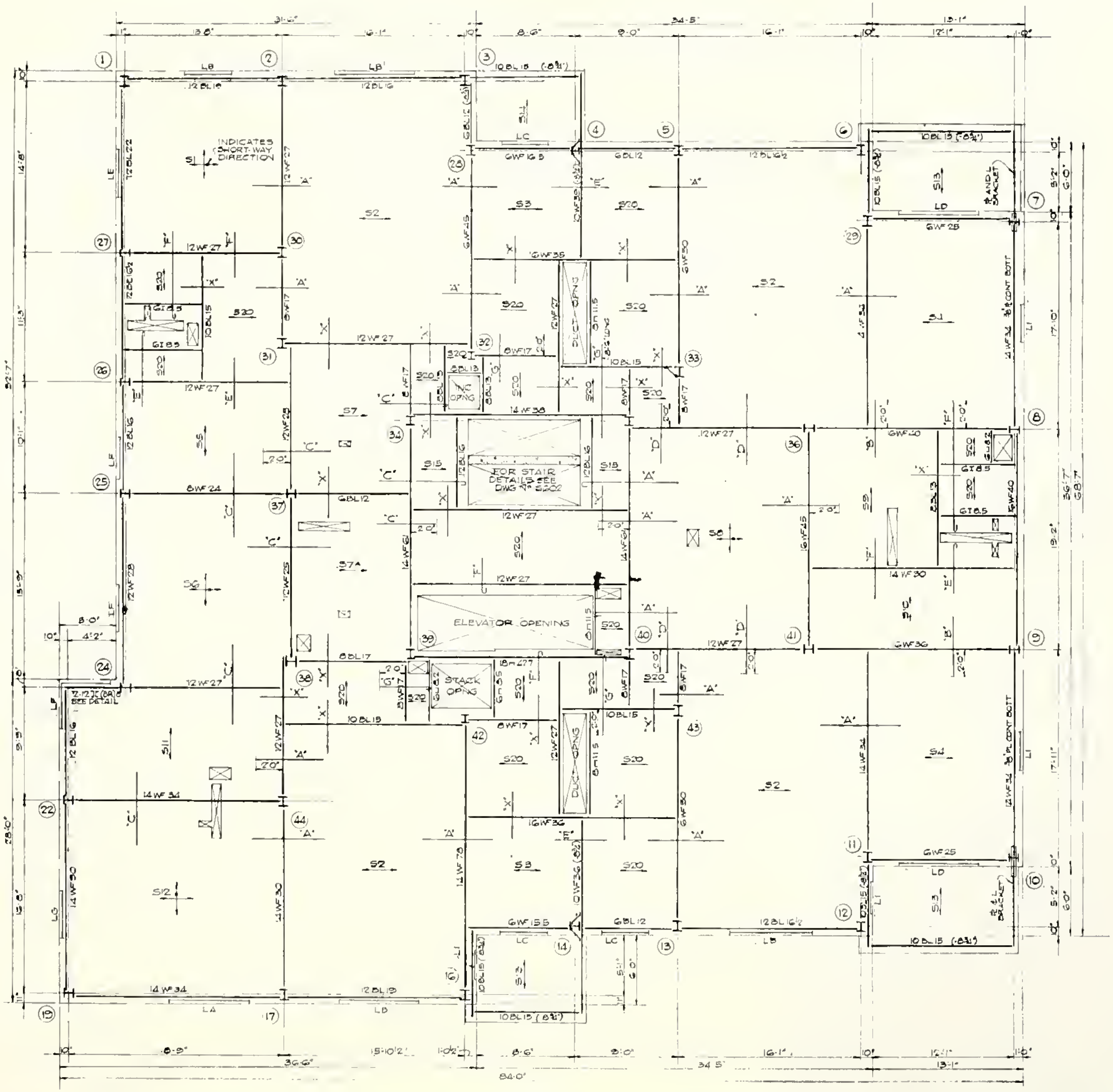
8. The development of welded construction has still not reached its full economy, partly because the enormous amount of riveting equipment must be amortized, but, as the welding technique develops and the frame is designed to take advantage of all the elements of continuity, steel quantities can be materially reduced.

9. Last but not least, formwork is greatly minimized, resulting in a great reduction of costly field labor.

Framing Systems — Short Span

The simplest framing system of all is the well known short span system of stone concrete or lightweight concrete reinforced with wire mesh. This, with its steel beam, is shown in Fig. 41. Using stone concrete, the floor slab can often span between partitions so that no filler beams will be completely exposed in the ceiling. A section of a floor framing on this basis is shown in Fig. 42.

Partitions are shown in outline to indicate the relative position of the beams and the partitions. The handling of conduits with this type of construction must be carefully considered. Figure 43 shows how conduits are brought up through the partition and arranged so as not to interfere with the reinforcing bars.



SLAB SCHEDULE

MARK	DEPTH	BOTT. REINFORCMENT SHORT WAY	LONG WAY	REMARKS.
S1	4½"	⅜φ-7½	⅝φ-8½	FOR TOP REINF SEE PLAN
S2	5½	½φ-5		
S3	4"	⅜φ-7		
S4	5"	⅜φ-4½		
S5	4"	⅜φ-5½		
S6	5"	⅜φ-7	½φ-8	
S7	4½"	½φ-7½		
S7A	5"	½φ-7½		
S8	5½"	½φ-7	⅜φ-5	
S9	5½"	½φ-6		
S10	4"	⅜φ-7		
S11	4½"	⅜φ-5½		
S12	5½"	½φ-8½	½φ-9	
S13	5½"	⅜φ-9½		
S14	4"	⅜φ-7		
S15	4"	⅜φ-8		
S20	4"	⅜φ-8		

SLAB TOP BARS ARE MARKED THUS 'A' 'B' 'C' ON PLANS, FOR SIZE AND SPACING SEE THE FOLLOWING SCHEDULE

MARK	SIZE & SPACING
A	½φ-5½
B	½φ-7½
'C'	½φ-8
'D'	½φ-9
'E'	½φ-11
'F'	½φ-12
'G'	⅜φ-12
'X'	⅜φ×4-0"@12"c.

NOTES

1. FOR GENERAL NOTES AND TYPICAL DETAILS SEE DWG No S601
2. TOP OF STRUCTURAL STEEL MEMBERS 2" BELOW TOP OF CONCRETE SLAB UNLESS OTHERWISE SHOWN THUS [-0"]
3. L1, LA TO LG INCLUSIVE ARE LINTEL MARKS FOR DETAILS SEE DWG S602.
4. FOR ADDITIONAL REINF. AT SLOT OPENINGS SEE DWG S602

TYPICAL FLOOR FRAMING PLAN

Fig. 44.

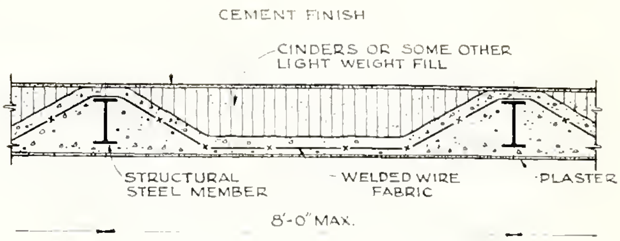


Fig. 45.

A sample of a complete framing plan where all the beams are at the partitions is shown in Fig. 44. As will be noted, the framing is a combination of one-way and two-way solid concrete slabs. The stair construction is handled in a similar manner as for a reinforced concrete frame.

Using lightweight aggregate only, such as cinder concrete and gritcrete (a lightweight concrete produced by mixing aluminum powder with the aggregates with the resulting expanding of the mix and creation of internal finely dispersed air pockets) the customary span is 8′ and the maximum permissible span is 10′. Therefore, it is usually not possible to keep all beams at partitions. Where these beams pass through the ceilings of a room, they are either kept at a minimum depth to provide the maximum clear headroom or sometimes a "bottom arch" is used. This is shown in Fig. 45.

Lightweight concrete usually requires plaster ceilings. Sometimes an attempt has been made to eliminate plaster by pouring a grout on the form before the lightweight concrete is poured. However, this is rather difficult to do, since either the poured concrete will scour away the grout if it is not sufficiently set, or else the grout will have set to such an extent that it does not bond with the concrete and eventually scales off.

Sometimes lightweight concrete is used for the smaller rooms where the beams can occur at partitions and stone concrete over bigger rooms such as the living rooms so that the minimum story height can be obtained and objectionable beam haunches eliminated.

Some owners have an objection to plastering on stone concrete. It is not practical with a combination as outlined to plaster the lightweight concrete ceilings and paint

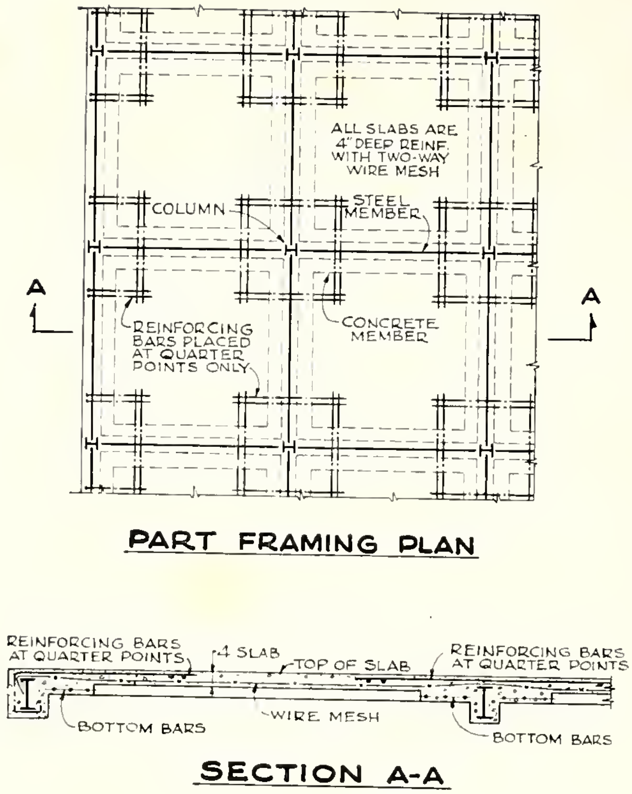


Fig. 46.

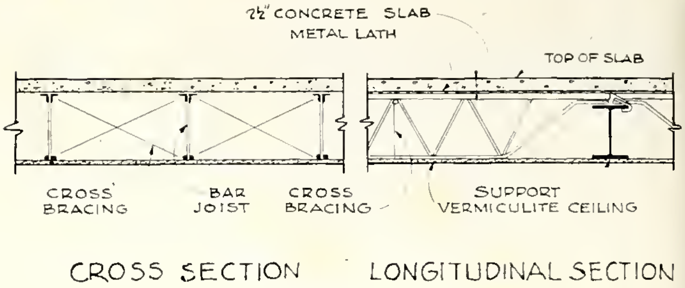


Fig. 47.

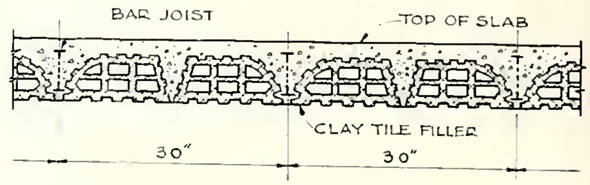


Fig. 48.

the stone concrete ceilings directly. However, we have found that, for relatively small areas, properly executed plastering job on stone concrete is satisfactory.

Rizzi-Severud System

This system is a two-way concrete floor panel reinforced with mesh in two directions. Along the beams are slab bands that stiffen the plate for negative moments and generally strengthen it where the stresses accumulate. To get away from the usual complicated two-way design methods the analysis has been so arranged that only simple loading of the beams results both for moments and shear. The exterior beams have been strengthened for torsion so that exterior panels can be designed as if they were continuous. This "continuity" is provided by the torsional resistance of the spandrels and the bending value of the exterior columns. In this manner an extremely simple design analysis results and there is also a very economical distribution of materials. We haven't yet put this construction to the test but an estimate by a responsible contractor indicates that it may have merit. I believe it is beyond the scope of this book to enter into the description of the design methods but the results are shown in Fig. 46.

Steel Joist Construction

This method has the great advantage that all formwork is entirely eliminated. It is also very light and will, therefore, result in a reduction of the cost of the supporting frame and the foundations. Recent fire tests have proven that a ceiling made of vermiculite plaster renders this floor construction completely fireproof. We have found, however, that it has the disadvantage of resulting in greater story heights, and that it usually cannot compete with a poured in place slab. It is also quite noise transmitting and is, in our opinion, not quite so attractive as it appears to be on paper (Fig. 47).

One system using the steel joist is quite intriguing. This is a system developed by Erford Littlejohn. As will be seen from Fig. 48, it is fully fireproof and provides a

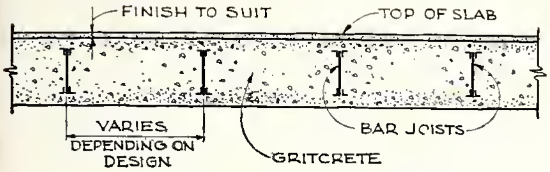


Fig. 49.

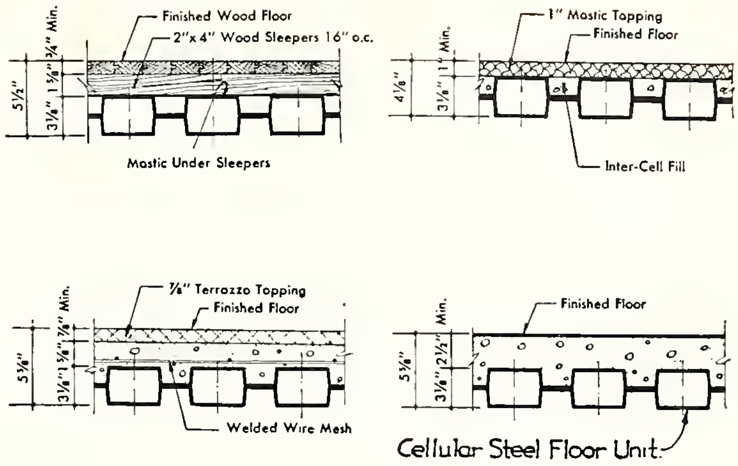


Fig. 51.

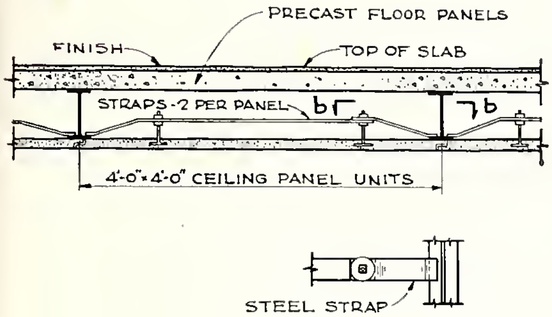


Fig. 50.

flat ceiling ready for plaster. Although this system also eliminates formwork, it is a question if cost of materials and installation may not be too much of a handicap. It has not been used in recent buildings so the cost factors are at the present quite uncertain.

Another way of using steel joists is shown in Fig. 49. Here the space between the joists is filled with a gritcrete so that flat top and bottom surfaces result. This system has been used but I believe it is expensive.

Precast Ceilings

It is quite possible that future developments in precast panels may make steel joists very popular. As an example of such a development we show a type of construction in Fig. 50 that has been suggested by one of our engineers. There can, of course, be many variants on this theme. We know of no practical application of this general principle and cannot, therefore, comment on the cost factor.

Steel Decks

Many steel decks have sprung to life recently, not only for roofs but also for floors. The H. H. Robertson's "Q" floor system shown in Fig. 51 has met with a considerable success for installations where flexibility in the electrical layout is important, such as in department stores and in laboratories. We have found, however, that none of these decks are at present within competitive range for apartment house construction. Should form costs take a further jump, this situation may be changed. We believe that this system and others such as developed by Truscon and Fenestra could take advantage of the strength developed by a combination of the concrete cover and the steel deck. This could be done very simply by providing for uplift and bond forces and thereby create a system where the forms also act as permanent reinforcement.

A development of this kind which might have some merits is shown in Fig. 52. This

has been developed by our office but we have never put it to the test of actual construction.

Closet Columns

It would seem tempting to use the waste space in a steel column in some way or another. This becomes more possible with the recent development of vermiculite plaster for column fireproofing. In Fig. 53 is shown a steel column that departs from the usual H shape and takes the form of a closet. Such a closet column could be used in connection with both steel and reinforced concrete frame. The difficulties of producing this column economically may not be worth the relatively small amount of space saved. But space-saving is such a dominant factor in apartment house construction that I mention the idea for what it is worth.

Local Materials

Before leaving the subject of steel construction, I should like to mention a rather interesting solution to a local problem. In an oil town down south a great amount of typical buildings were required to house the workers. I discovered that a local narrow track railroad used in the operation of the refinery was being abandoned. Figure 54 shows various details of an efficient use of rails in the upper line (as filler-beams) and in the lower line as reinforcement of a concrete girder. Continuity steel is accommodated by pouring some concrete covers over the posts. Between the filler rails is a 2¾″ thick concrete slab draped over the rail heads and reinforced with a very light mesh. Insulation is provided by earth and poured asphalt which also was locally produced as a byproduct of the refinery furnished the roof covering. This construction wouldn't stand a rigorous or wet climate but it serves as a very economical way to meet local problems and use local materials.

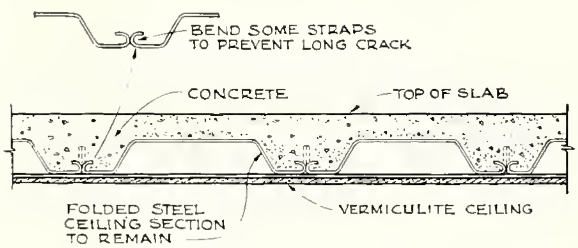
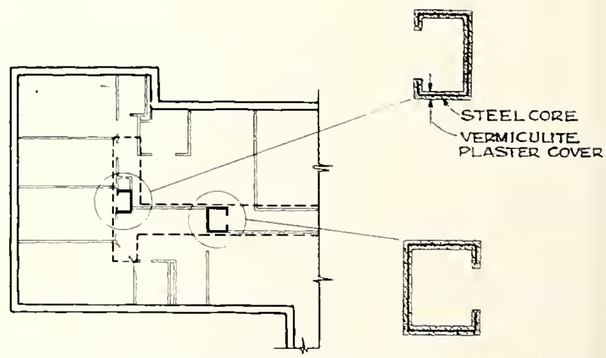
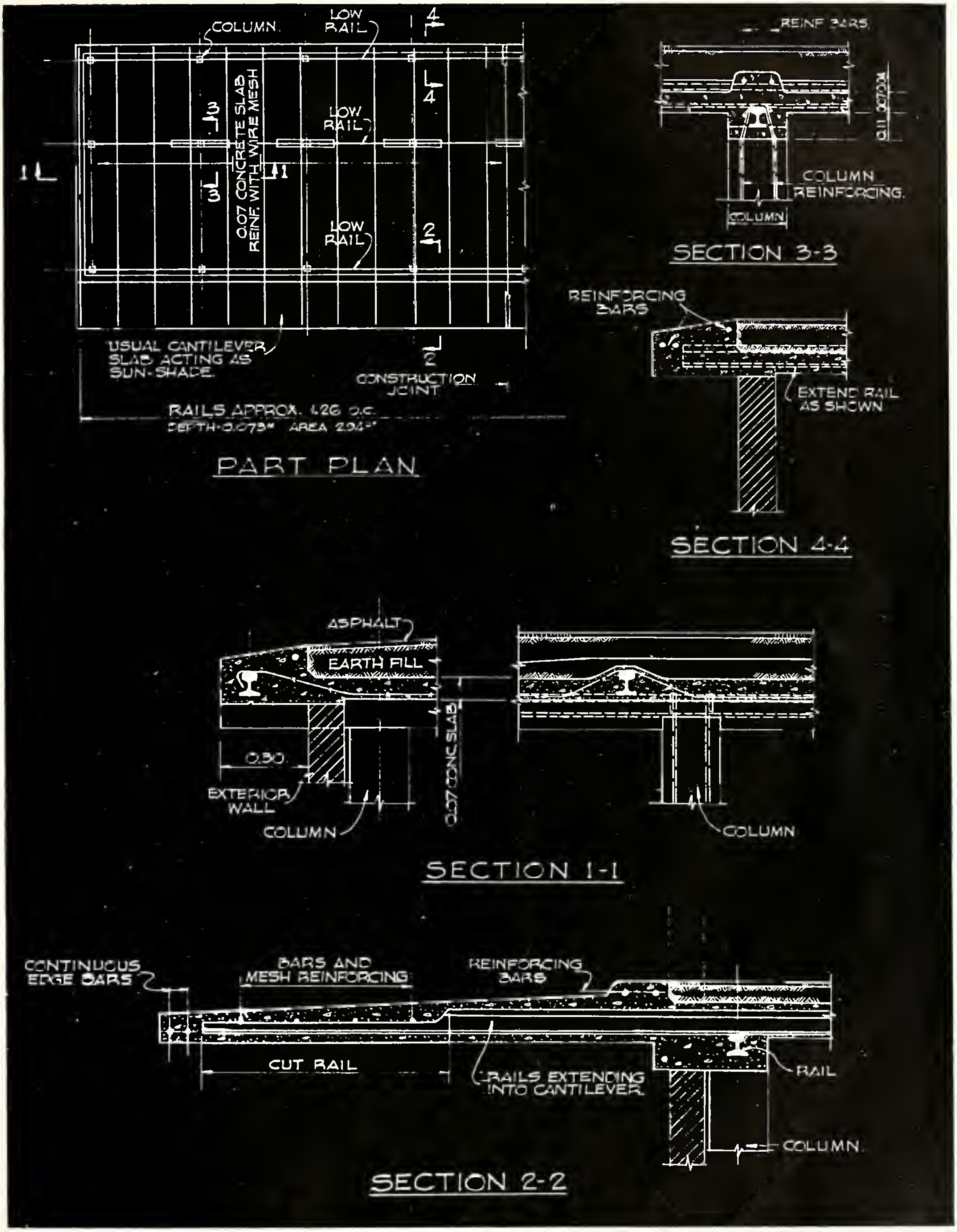


Fig. 52.



LAYOUT SHOWING AUTHORS PROPOSAL
FOR STRUCTURAL SHAPES
BASED ON PARTITION DIMENSIONS

Fig. 53.



COLUMN
LOW RAIL
0.07 CONCRETE SLAB REINF. WITH WIRE MESH
USUAL CANTILEVER SLAB ACTING AS SUN-SHADE.
CONSTRUCTION JOINT
RAILS APPROX. 1.26 o.c.
DEPTH-0.073" AREA 2.94"
PART PLAN
REINF BARS
COLUMN REINFORCING.
COLUMN
SECTION 3-3
REINFORCING BARS
EXTEND RAIL AS SHOWN
SECTION 4-4
ASPHALT
EARTH FILL
0.30
EXTERIOR WALL
COLUMN
0.07 CONC SLAB
COLUMN
SECTION 1-1
CONTINUOUS EDGE BARS
BARS AND MESH REINFORCING
REINFORCING BARS
CUT RAIL
RAILS EXTENDING INTO CANTILEVER.
RAIL
COLUMN.
SECTION 2-2

Fig. 54.

CHAPTER 4: Framing Systems—Wood

Recent development of other materials has relegated wood as the basic framing medium to the background in so far as apartment houses are concerned. Even for two and three story buildings, we have found that fireproof construction is more economical even in first cost. Following are some of the reasons for this apparently extravagant statement: **Wood**

1. Taking reinforced concrete as a basis for comparison, we have found that the story heights can be greatly reduced compared to wood construction.

2. Present painting techniques allow for the use of painted concrete ceilings even for high class apartments. Plaster can, therefore, be eliminated with concrete construction.

3. With concrete construction, most of the partitions can be made of 2″ solid plaster. These are very economical and space saving.

4. Unless wood floors are required, savings can be made in floor finishes.

5. By using skeleton frame a more economical wall section can be selected.

In addition to savings in first costs, fireproof construction entails less maintenance and, of course, smaller insurance. It is also a "selling point" in renting the apartments.

For the reasons outlined above, and also because wood construction has become thoroughly standardized, no effort will be made here to go into this type of construction at all. Such new developments as plywood beams and plywood panels have a far flung field but do not include apartment house construction at the present time or within the near forseeable future.

CHAPTER 5: Wall Construction

ALL SPANDREL REINFORCEMENT TO BE INCREASED FOR "CRACK" RESISTANCE AND TO BE FULLY CONTINUOUS AROUND THE WHOLE PERIMETER OF THE BUILDING

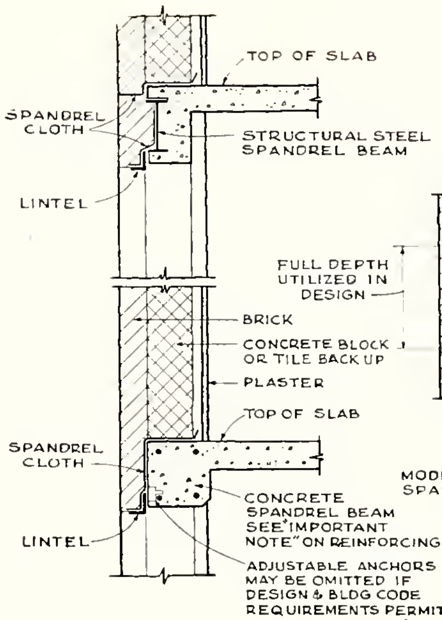


Fig. 55.

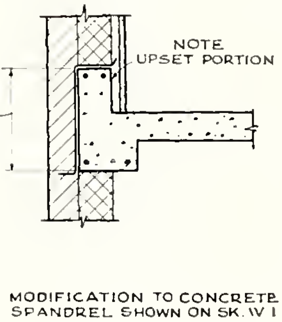


Fig. 56.

Standard Wall Construction

So many clever definitions of the function of a wall have been given that I won't bore you with my own. It's pretty obvious that a wall should be able to provide the proper climate in the building, keep out moisture, and not fall into the street in a windstorm or during a fire. Let us first get the so-called "standard wall" construction out of the way.

The wall (Fig. 55) is very serviceable, is relatively light, and easy to construct. It is always best to fasten the lintel angle to the spandrel by adjustable inserts because otherwise a lot of money is spent in setting it accurately and, even then, it may not fit the masonry. From a standpoint of engineering, this wall is perfectly stable with loose lintels over the windows, and many apartment houses have been built that way. Recently the Building Department of New York City has become concerned about the support of this wall on the spandrel and now requires it to be supported for at least two-thirds of the perimeter by an angle that is anchored to the spandrel. The reason I believe this requirement unnecessary is that the wall acts as an arch between the supporting spandrel and the spandrel above. We have made analyses to show that it would require considerably more than an earthquake force to collapse the wall and we invariably use loose lintels where we are not restricted by code requirements.

The furring is kept free from the wall and is usually of metal lath and plaster. One variance to the general theme shown in Fig. 55 is the construction in Fig. 56. One reason for the upset spandrel was to keep the spandrel flashing off the floor. Sometimes this cloth gets stepped on and punctured. One contractor expressed that the upsetting of the spandrel was very simple to do but in a few cases he had to chip the concrete to allow for the furring stud, because the inner concrete edge of the upset portion has been poured a little wavy.

In both these types, in fact regardless of what the wall construction is, it is im-

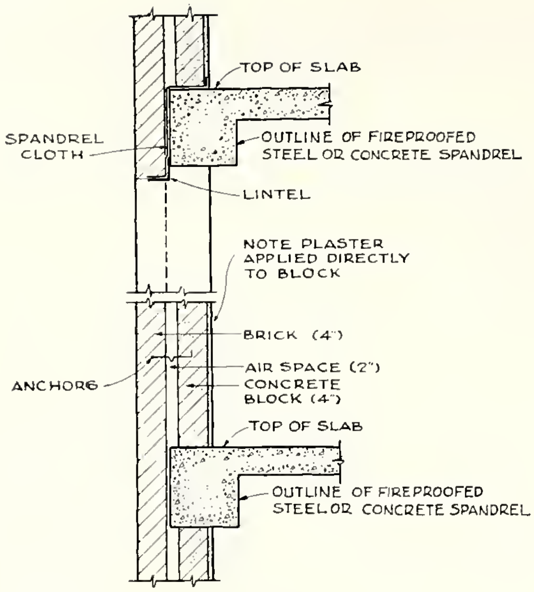


Fig. 57.

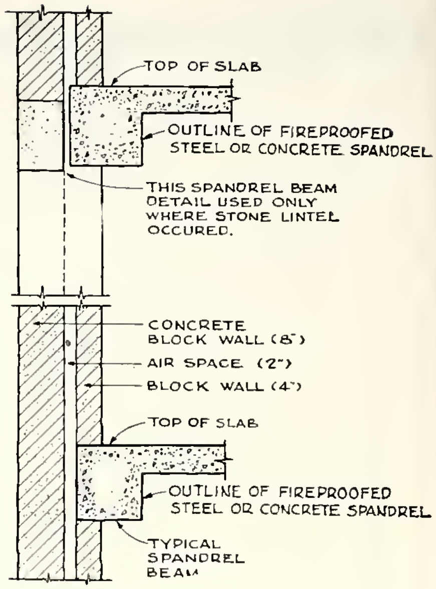


Fig. 58.

portant to recognize that the "open" edge of a concrete plate is where the cracks normally attack it. By "binding" this edge the most efficient way has been found to prevent cracks in the plate, just as the binding of the edge of a piece of paper prevents a tear. More about this under "Construction Pitfalls."

Cavity Wall

The construction shown in Fig. 57 is what is known as a cavity wall, consisting of 4″ of brick, 2″ of air space, and a 4″ cinder concrete block. On a recent project it was found by taking alternate bids, that there was about 15% saving over "standard" wall as shown in Fig. 55.

The first cavity wall construction designed by us was in 1940. It consisted of a concrete skeleton six stories high and a cavity wall of the same type as shown in Fig. 57, except that brick was used also for the inner withe. It was so eminently successful that since that time we have favored the cavity wall construction wherever a masonry wall was required. It is fully approved by the New York City Building Department and has been tested for load and for fire.

During the war we designed and supervised the building of miles and miles of cavity walls construction usually of a type shown in Fig. 58. There is no reason why such a type could not be used for apartment house construction if the appearance of concrete block is acceptable. The reason for using an 8″ outside wall was to eliminate the wall ties. Experience has proven that even a cavity wall constructed of two withes of 4″ block is perfectly weatherproof. In Figs. 59, 60 and 61 is shown a cavity type wall where the cavity is extended to the shelf angle to eliminate the necessity of flashing. With this type the corrosion of the angle must be given serious attention.

With a cavity type it is usually required to use continuous angles throughout the perimeter of the wall. Sometimes we have stopped the angles short at the columns

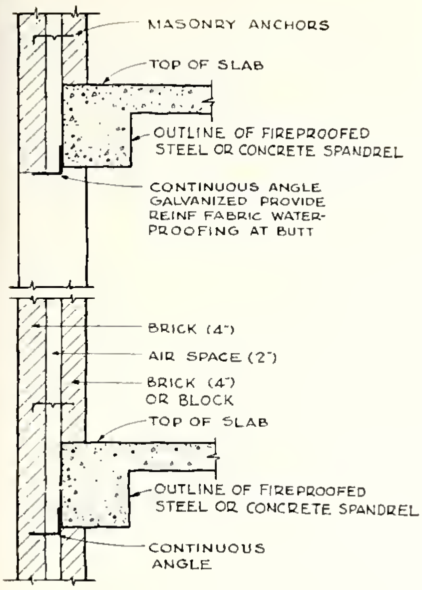


Fig. 59.

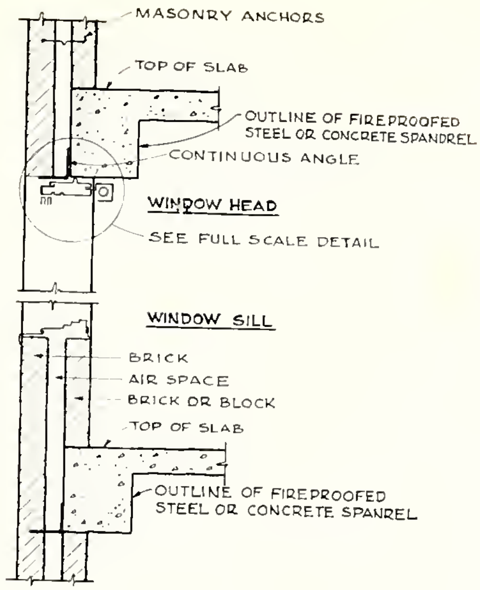


Fig. 60.

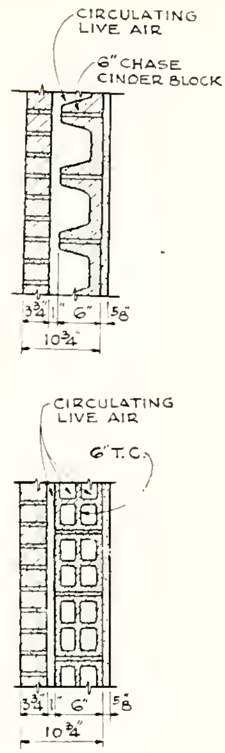


Fig. 61.

leaving a gap of about three feet which arches over from one shelf angle to another. This gap saves steel, and also reduces temperature stresses. For long buildings we have sometimes used a pencil rod to bridge this gap so that there are no temperature cracks at the ends of the angles. A general arrangement of these details is shown on Fig. 62.

The wall that is shown in Fig. 63 has given excellent results. It was used for three and four story buildings. We used 12" there since that is the code requirement but there is no good reason why an 8" wall wouldn't do as well for low buildings. One advantage with this type of a wall is that a great amount of flashing is eliminated.

Precast Wall

On a dormitory building for the University of Vermont (McKim, Meade & White, architects, and Fred N. Severud, consulting engineer) the contractor, Edmund J. Rappoli Co., Inc., found that it was more economical for them to use a precast 6" solid concrete panel for the inner withe. Preliminary research by the contractor established that this method could be used successfully and economically.

One very interesting variant to the cavity theme is a wall that has been developed by Mr. J. J. Fricano, now with Skidmore, Owings and Merrill, architects. By inserting especially shaped pipes placed in the wall at the columns and at each floor, all the internal cavities are interconnected, providing a wall which, according to its inventor "breathes 24 hours a day."

H. H. Robertson Wall Panel

The Country Life Press Building makes interesting use of this wall system. The wall consists of insulating Robertson "Q" panels. "Q" panels can be fabricated from Galbestos, a specially protected metal perfected by the Robertson Co., aluminum, stainless steel, galvanized and black steel. The same metals can also be used for enclosing the insulation. These plates can be turned outside to produce a flat surface as shown in Fig. 65. A typical arrangement for this type of construction is shown in plan.

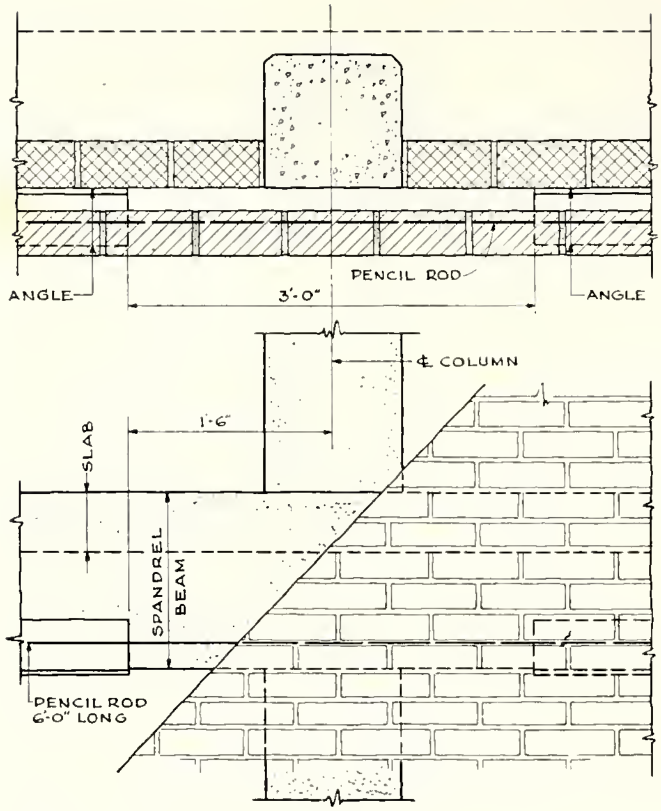


Fig. 62.

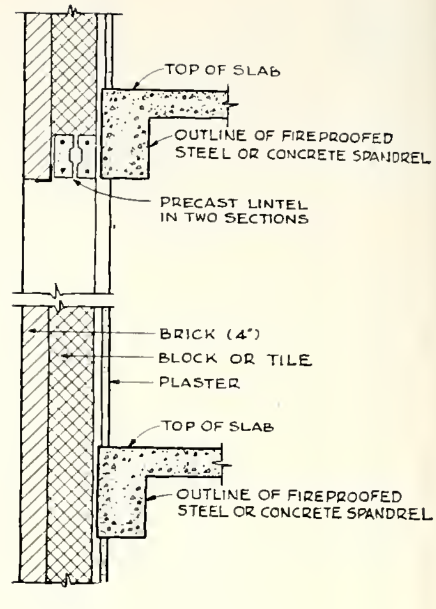


Fig. 63.

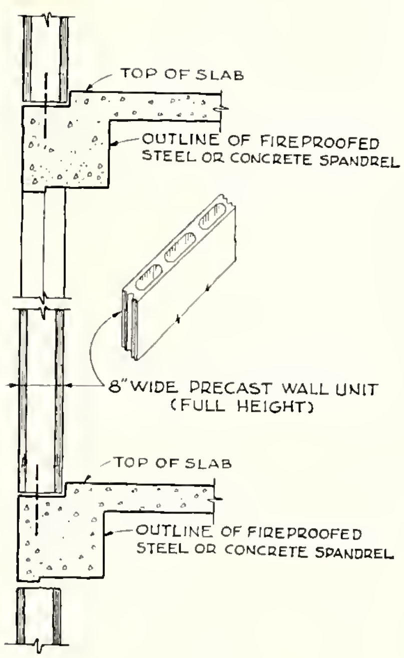


Fig. 64.

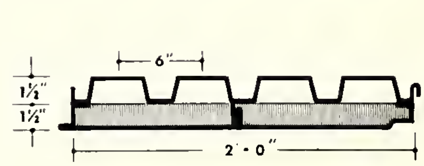


Fig. 65.

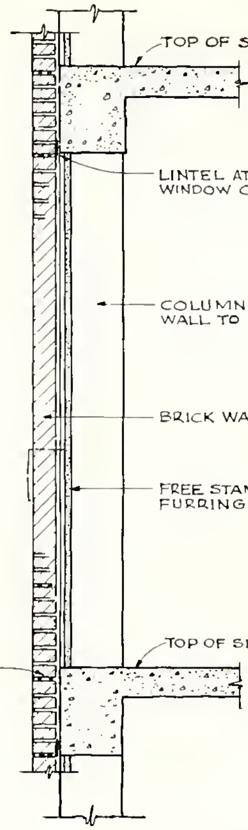


Fig. 66.

Precast Building Sections
Fig. 64

This wall was originally developed by Grosvenor Atterbury, architect, and was first used for a group of forty houses in Forest Hills, L.I., built between 1910 and 1920. The results have been unusually good both from the standpoint of water penetration and condensation. It consists of a concrete wall panel which can be cast to a maximum height of 10′ with numerous variations within these limits. Concrete is poured into a form containing heating coils which increases the density of the concrete and makes it possible to remove the forms after an hour. I have for years been interested in eliminating shrinkage cracks in concrete as it shrinks, or better yet a step ahead of it. On my advice, the heating and cooling have been so timed with this wall panel that exactly such a result is obtained.

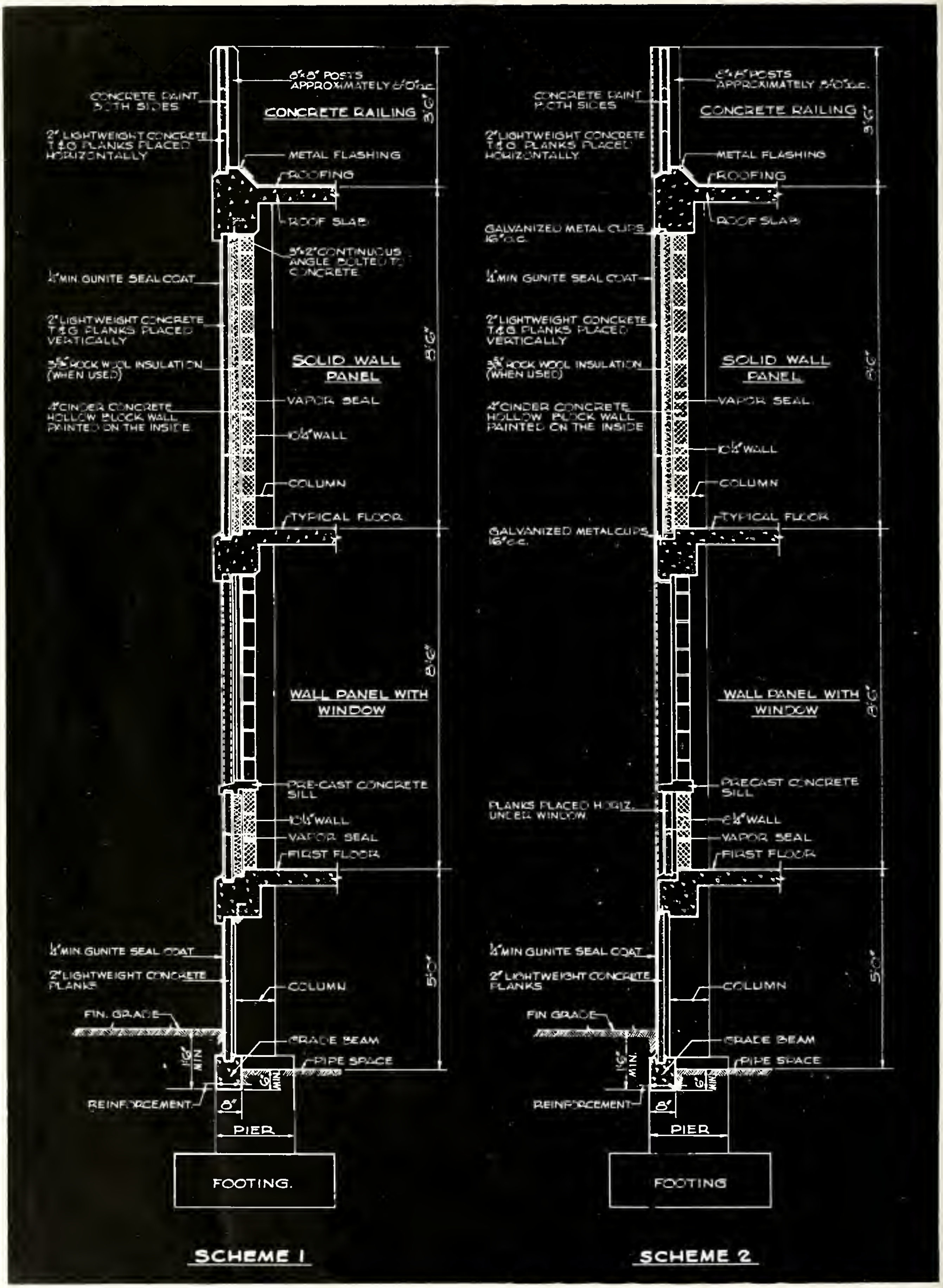
This wall section gives a finished inside and outside smooth concrete surface and if the erection is handled efficiently, it should provide a very economical wall. Using lightweight aggregates there should be no trouble in getting a two hour rating for this type of wall. Most Building codes previously containing severe requirements of fire-resistance for outside walls are now being revised. In Washington, a two hour fire rating is the maximum and before long this will probably also be the case in New York City.

Although the previous installations with this wall type have all been wall bearing, there is no reason why this wall cannot also be adapted to skeleton frame constructions as shown in Fig. 64.

In general, I believe that this wall system is worthy of the most careful attention and may have great potentialities. Being produced without insipient shrinkage cracks it should be almost indestructible and devoid of maintenance.

Four Inch Brick Furred
Fig. 66

This wall may look a bit drastic. However, by tieing it to the columns and reinforcing



8"x8" POSTS APPROXIMATELY 6'-0" o.c.
CONCRETE PAINT BOTH SIDES
CONCRETE RAILING
3'-6"
2" LIGHTWEIGHT CONCRETE T. & G. PLANKS PLACED HORIZONTALLY
METAL FLASHING
ROOFING
ROOF SLAB
3"x2" CONTINUOUS ANGLE BOLTED TO CONCRETE
GALVANIZED METAL CLIPS 16" o.c.
¼" MIN. GUNITE SEAL COAT
2" LIGHTWEIGHT CONCRETE T. & G. PLANKS PLACED VERTICALLY
SOLID WALL PANEL
3⅝" ROCK WOOL INSULATION (WHEN USED)
8'-6"
VAPOR SEAL
4" CINDER CONCRETE HOLLOW BLOCK WALL PAINTED ON THE INSIDE
10¼" WALL
COLUMN
TYPICAL FLOOR
WALL PANEL WITH WINDOW
PRE-CAST CONCRETE SILL
PLANKS PLACED HORIZ. UNDER WINDOW
FIRST FLOOR
5'-0"
2" LIGHTWEIGHT CONCRETE PLANKS
FIN. GRADE
GRADE BEAM
PIPE SPACE
1'-6" MIN.
6" MIN.
REINFORCEMENT
8"
PIER
FOOTING.
SCHEME 1
SCHEME 2

Fig. 67.

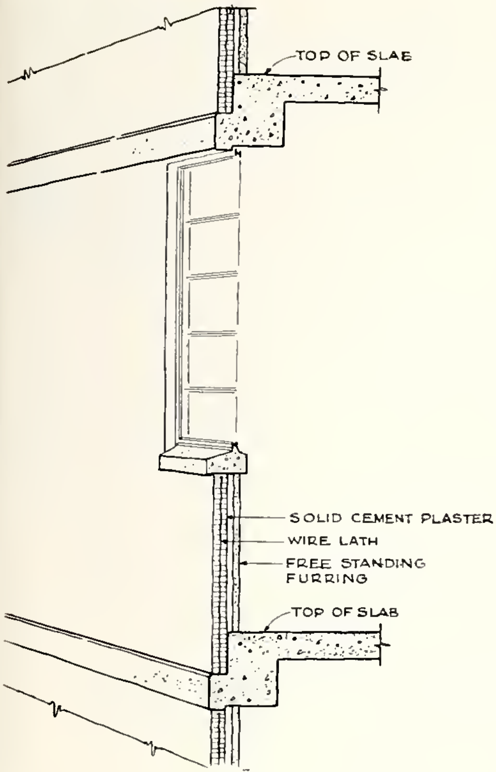


Fig. 68.

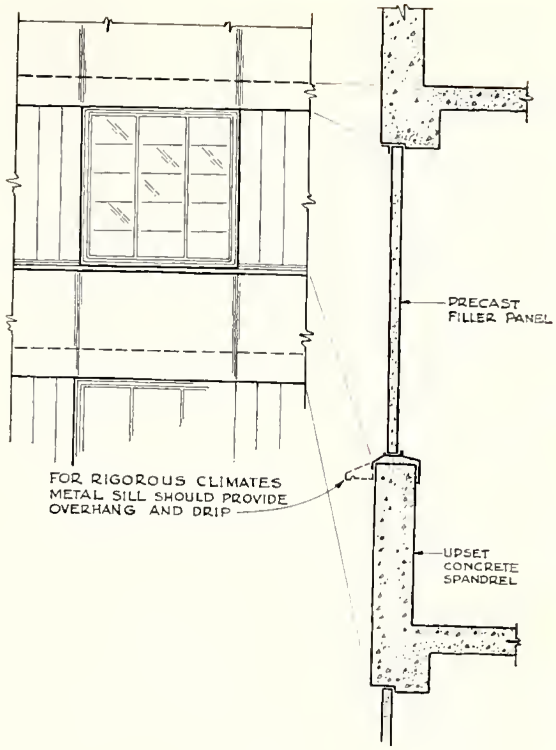


Fig. 69.

it in the joints as shown, there is nothing wrong with it from a structural standpoint. The free-standing furring insures full weather protection. I have designed a large project in South America where even the furring was omitted because of the dry and warm climate, and only a reinforced 4″ brick was used, although they have occasional earth tremors.

The main difficulty with a wall of this type (Fig. 66) is that it is a rather radical departure from ordinary construction, but the objections are more psychological than real. The insulating qualities are poor, unless vermiculite plaster is used for furring.

Plank Wall
Fig. 68

A wall made of concrete plank on the outside, an air space, and then either a concrete block, another plank or free-standing furring to form the inner surface. We have never built any of these types and offer them only as possibilities. A gunite stucco might be required on the outside for weather tightness. Parapet walls are concrete planks between concrete stub posts.

Stucco Wall
Fig. 70

A wall constructed like a solid plaster partition, using cement plaster instead of gypsum plaster. This can, of course, be combined with any kind of free-standing furring. It would make a very durable wall but we have never used it and I don't know just how practical it would be.

Upset Spandrel Wall
Fig. 69

One type of wall that has aroused considerable interest among some of our clients is one where a spandrel beam is used as a wall underneath the windows and then a filler panel used between the windows.

Upset Spandrel Wall with Filler Panel
Fig. 71

Wall developed by Mr. Ovodow of the New York City Housing Authority. The difficulties with any walls of this type are the joints, but by exercising some ingenuity

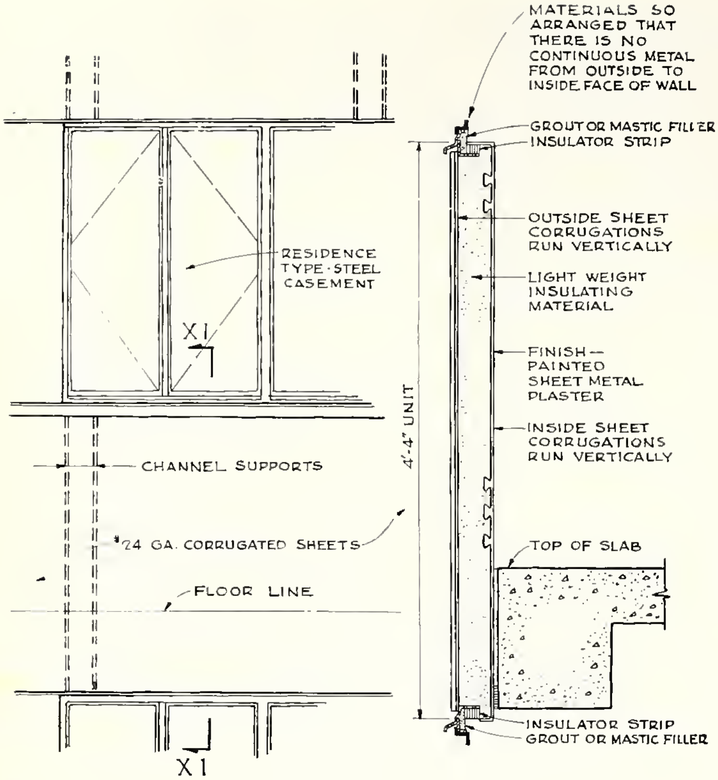


Fig. 70.

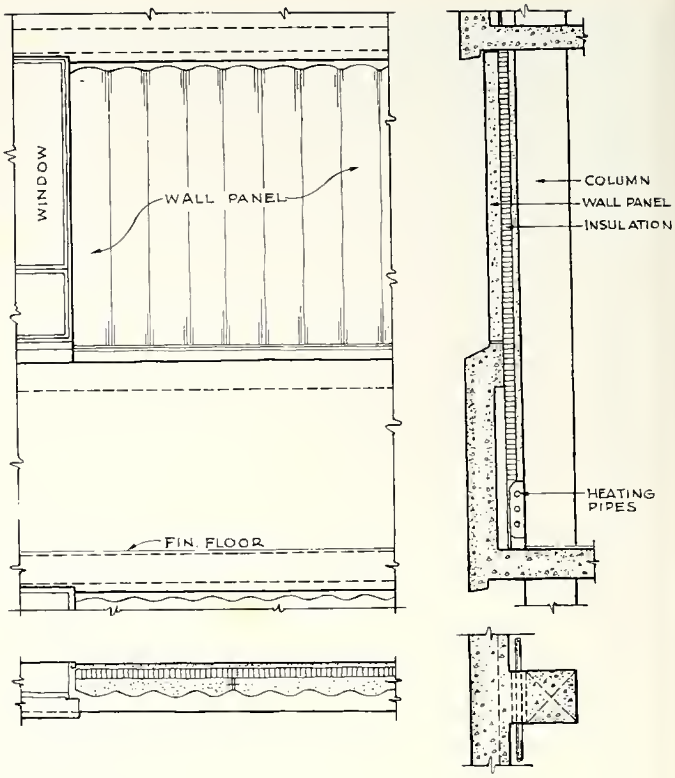


Fig. 71.

this difficulty is not insurmountable. There are so many variations of these details that I'll leave it to you to make your own filler panel if a wall of this type should interest you. Structurally, it has the great advantage that no rigid member except the exterior column connects one story of a wall with another. This gives great freedom from temperature and shrinkage stresses and makes the use of exposed concrete even in rigorous climates a possibility.

We caution, however, that should you contemplate using exposed concrete in severe climates, the provision of an overhang to provide a drip for vertical rain is almost a necessity for good results. This can readily be done by using continuous window sills that will also provide the flashing for the filler panels. A construction of this type is shown, dotted, in Fig. 69, but I don't want you to get too excited about any of these wall types until you have found out what you want to do at the corners and in special conditions.

Metal Clad Wall
Fig. 70

Mr. William Lescaze and Mr. Robert L. Davidson have been commissioned by the New York City Housing Trust to make a study of metal lined walls. I have worked with Mr. Lescaze as his consultant. In Fig. 70 are shown the various details that have been developed. It is anticipated that by the time you read this a wall type of this kind will have been produced at various sections in the country. Great attention has been paid in the development of this system to follow through all erection procedures in every little detail so that the necessary clearances, tolerances, and adjustments can be made in a most direct and practical manner. My experience with a long procession of prefabricated sections, or assemblies, has taught me that the tremendous mortality in this field has been caused by developing beautiful things on paper but not realizing that a single misfit will upset the whole erection procedure, and cause a serious holdup on the job.

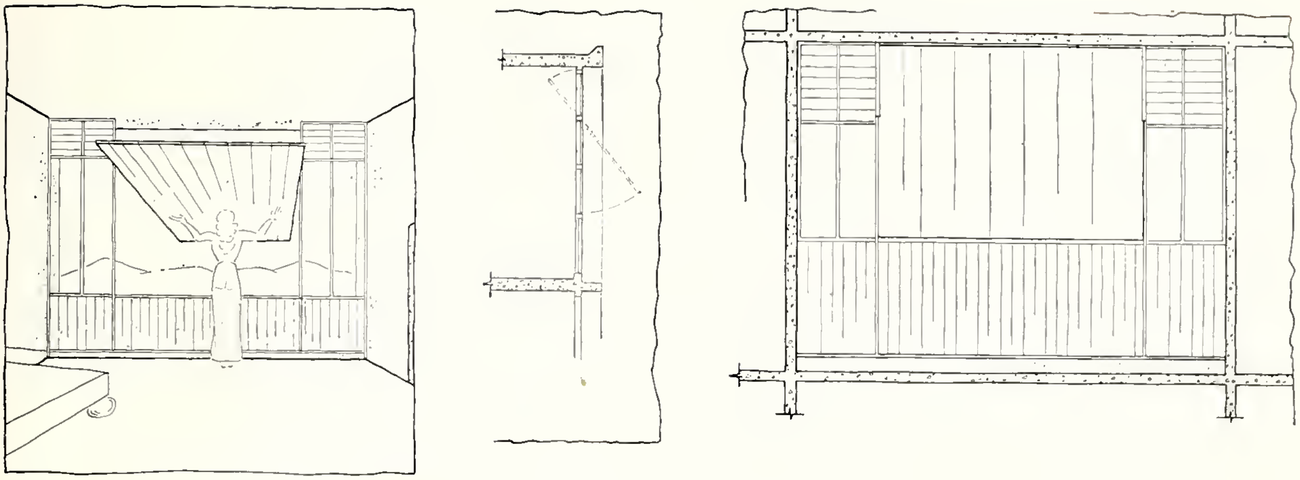


Fig. 72. Pivoted Wall Section. Progressive Architecture.

One great advantage with this type of wall over other metal lined walls is that the vapor pressure from the inside is relieved as it builds up through the joints between the panels. Without such relief, there is bound to be a great deal of condensation.

It is reasonable to expect that many developments similar to this will occur in the near future, particularly so with the relaxing of fire resistive requirements for exterior walls. I should like to put in a word of caution that the durability of the attachments is a very important item. If not properly designed, they may also cause a rattling during wind that may be very annoying. Experiments with similar types have proven that condensation of any metal connecting the two surfaces is a factor. I believe that a certain amount of condensation may not be objectionable since the tendency to condense on small areas will be balanced by evaporation, provided provision is made for relief of vapor pressure. It is, however, quite puzzling to observe how little condensation occurs on the frame of metal windows in ordinary masonry construction, and for that matter the window panes themselves.

The sketch, Fig. 72, shows an interesting disappearing wall. It may not be very practical but it certainly is in the trend of the time to bring nature in as much as possible.

A variation of the same thing is shown in Fig. 74. This is, I believe, a thoroughly practical wall and it has the advantage that the tenant can control his own fenestration and vary it with the seasons. The continuous windows give the necessary weather protection, leaving to the removable panel only the function of creating wall space and heat insulation. A further extension of this principle might be to have very light window sections that could also be removable, so that most of the time only a continuous netting would be between you and the outside.

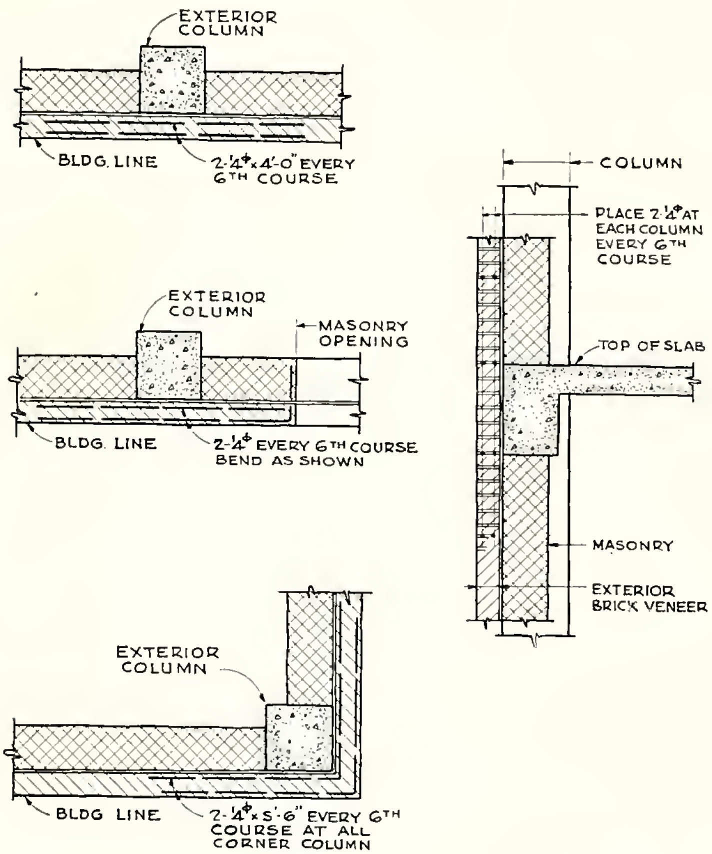
Column Location

Before leaving the subject of walls, I'd like to say a few words about how to locate the columns in relation to the wall. With the types shown in Figs. 55 and 56 there is a surprising saving in masonry by placing the column 5″ back of the wall. However, we know of many cases where the chases thus resulting in the walls caused serious leaks. The water driven through the facing of the columns may run down the sides of the column and find its way to the rooms near the base. We have, therefore, never dared place the columns in this location without using pencil rod reinforcement as shown in Fig. 73. However, we may have been unduly conservative in this respect.

With any cavity wall types, the columns are usually placed on the inner face of the cavity.

Parapet Walls

Rather than discussing parapet walls here, I thought it would be better to treat them in the chapter on "Pitfalls" because many are they that have fallen in the parapet "pit."



REINFORCING IN BUILDING WALL
MADE UP OF BRICK VENEER
WITH MASONRY BACK-UP

Fig. 73.

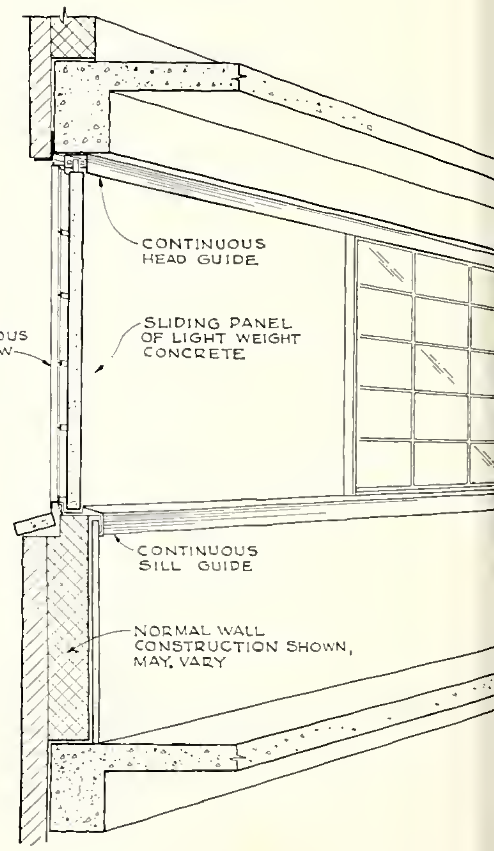


Fig. 74.

CHAPTER 6: Pitfalls

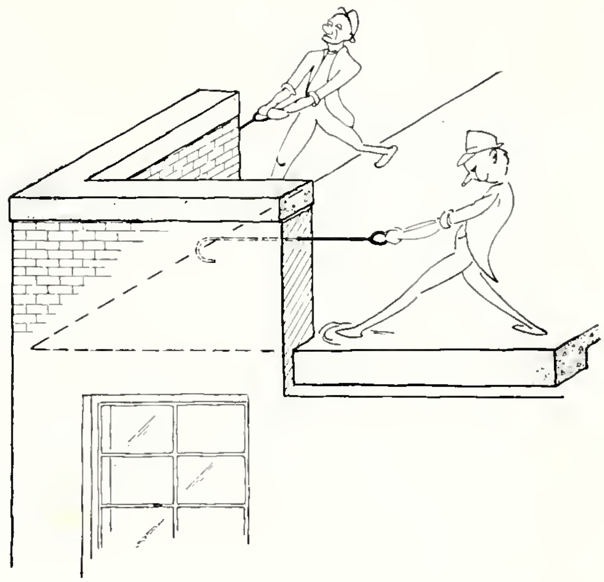


Fig. 75.

What is a crack? I say that not as a "crack," but because it is of a fundamental importance to know what happens when this great enemy of construction comes on the scene.

The simplest definition of a crack is that it is an explosion. Without going into lengthy argument to prove this point, let us rather be specific. Suppose we look at Fig. 75. This shows in diagram what happens at parapet walls. The two fellows pulling at each wall section at the corner start, let us say, with a very gentle pull on the hooks. They pull a little more and more, stemming their feet against the roof slab. Since this roof slab is in intimate contact with the brick work they can't pull the corner over bodily. The pull at the top is balanced by the push at the feet.

A similar action takes place on a cold day. This action is particularly emphasized if the roof slab is insulated. The heat from the ceiling keeps that roof slab yawning and stretching comfortably under the warm blanket. But not so with the poor parapet wall, huddling in the cold. This unlucky fellow is beset by cold air penetrating from three sides. So, instead of stretching, the parapet wall wants to *contract* in both directions away from the corner and towards the center of contraction, which is in the middle of each section of wall extending from the corner portrayed.

Now let us see what happens when the pull gets so great that the hook is pulled out. It lets go of the masonry with a bang, just as when you let go of the pea in the sling-shot. Only the chunk of masonry that flies off is a lot bigger than a pea and doesn't go so far. It is also stuck to the "rubber band of the sling-shot" by bricks and joints and by friction along the roof plate. All these factors tend to make the distance that the corner is thrown relatively small. The greatest I have observed is two inches. In Fig. 76 is shown the typical situation after the parapet wall is cracked.

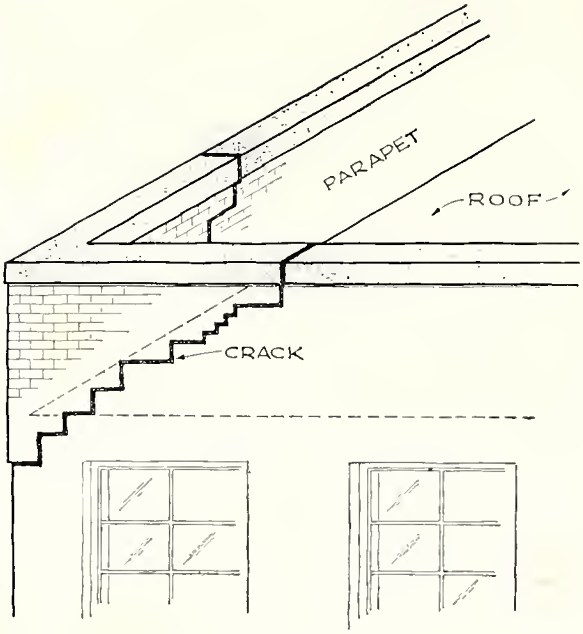


Fig. 76.

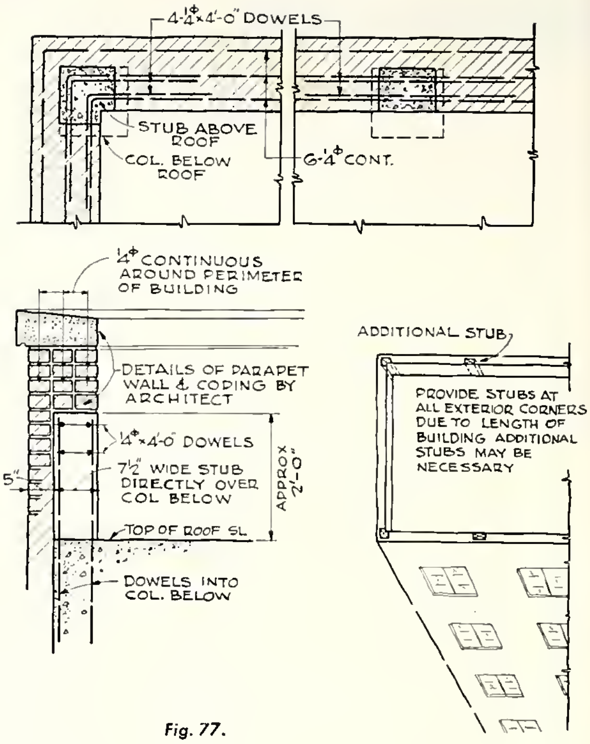


Fig. 77.

In explaining these matters to one of our engineers, some years ago, he got quite excited and said that finally a mystery that had puzzled him had been solved. During World War I he worked in a very long building. Suddenly, on a cold day a bang shook the building. They ran out, and here was the parapet wall corner, thrown out about 1½ inches. It wasn't hard to convince him that a crack is an explosion.

As mentioned before, the recent introduction of highly insulated roofs has greatly aggravated this pitfall. There has been a rash of cracked parapets all over the country. And if you do, as I do, look at parapet corners as you travel through the country, the story of parapet explosions is told repeatedly in cracked parapets or evidence of repairs or rebuilding.

Recently I was called in to design a big apartment house project. The architect had previously used a type of construction that he wanted me to follow. I told him that if I did his parapets would crack, but he just laughed and said that they never had had any trouble on the other project which had been built several years ago. This puzzled me to such an extent that I visited the job the next day. And lo and behold! That very day a gang of workmen was finishing up the rebuilding of the last of the four corners of one of the longest buildings! I found evidence that other corners had also been repaired. This incident is in accord with my general experience that trouble with parapets is not fully recognized by the designers of buildings because they become a maintenance problem and the superintendents just swear at the architects and engineers without going to the trouble of reporting back all the maintenance work they were put to.

In Fig. 80 are some excerpts from "Time Saver Standards" from the February 1946 issue of *Architectural Record*, which show various parapet details that we recommend to overcome this serious pitfall. Additional details are shown in Figs.

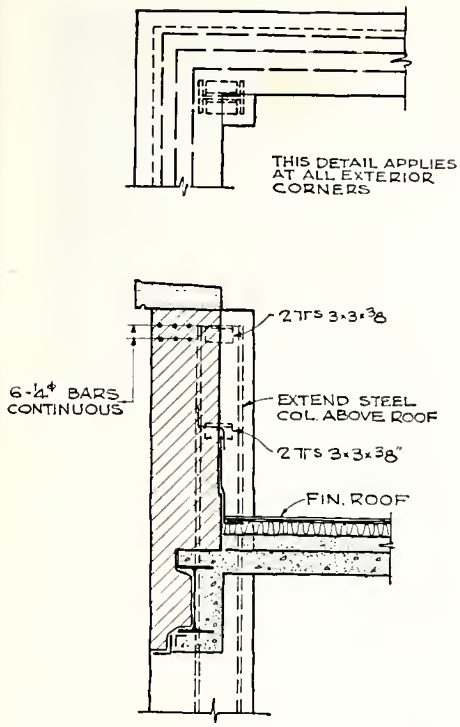


Fig. 78.

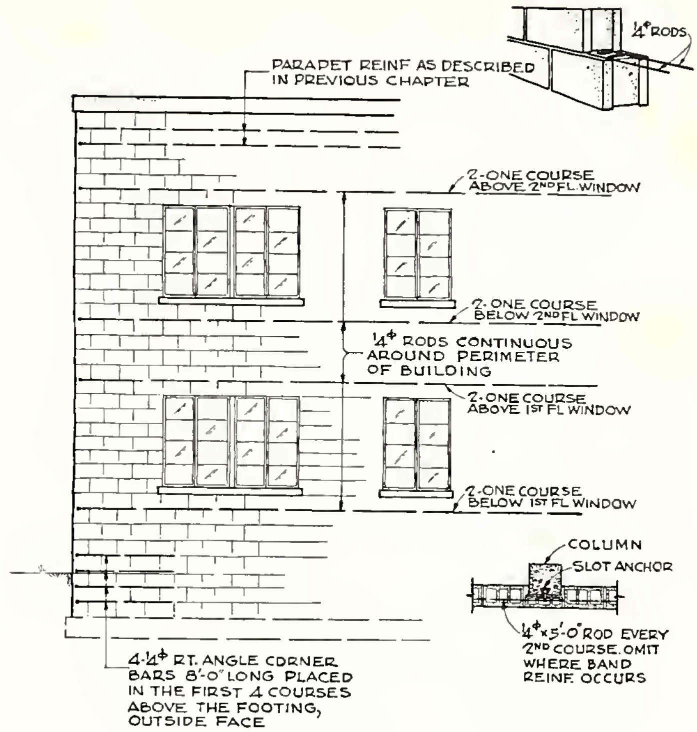


Fig. 79.

77 and 78. The sketches shown should tell you more than I can by mere description. Knowing the underlying factors, you'll probably be able to improve on them but there is one "improvement" that I caution against. This is to split up the parapet wall by small gaps. I have seen trouble with these free-standing sections twisting and warping. It may well be that by proper reinforcement cut-up parapets will work, but if the parapet walls cannot be eliminated which, of course, is the easiest way out, then I believe it's much better to make the wall fully capable of resisting the bending forces due to volumetric changes.

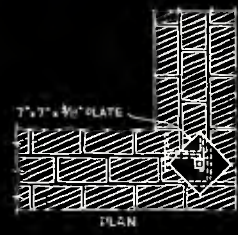
Block Walls

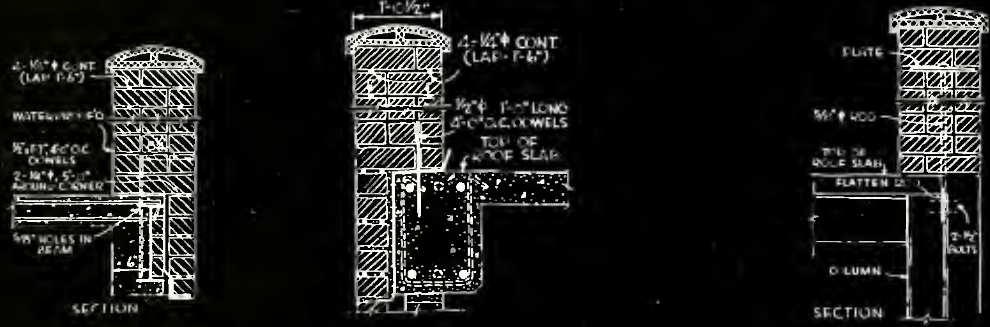
Block walls are more vulnerable to objectionable cracks than brick walls. The joints are few and far between and the block is more intimately held in the joints by mortar spilling around the webs. It goes without saying that the webs should not be buttered, but it is unavoidable that some mortar will be squeezed around them as they intersect the inner and outer flanges. There is, therefore, a much greater tendency for block construction to crack through the blocks rather than to distribute the cracks finely in the joints, as is more apt to happen in brick construction.

The main forces that block construction are subjected to are caused by the difference both in "temperament" and behavior of the sheltered horizontal construction and the masonry envelope, which is exposed to the outside. I don't believe you are particularly interested in the theoretical analyses that have lead us to adopt our method of reinforcement of block walls, but you should be interested in perusing Fig. 79 which gives the main principles that we have found to give remarkably good results.

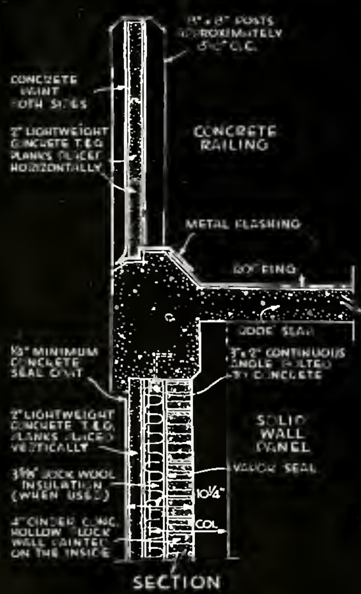
On a project consisting of about 50 two and three story buildings the walls were made of 8″ block painted and wood furring. Our client was afraid that the reinforce-

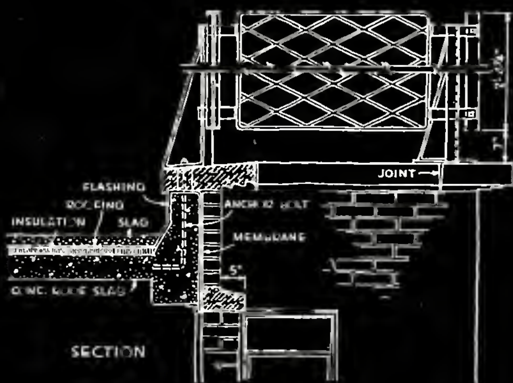
Standard details used in the office of Fred N. Severud, structural engineer, for tying the parapet walls against temperature strains. Steel rods run continuously through the wall itself and the brick courses immediately below it with steel dowels tying the wall to the spandrel beams

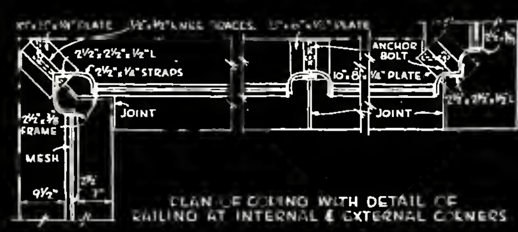




Here a concrete fence is substituted for the parapet wall. Concrete struts poured with the spandrel beams act as fence posts. Pre-cast concrete planks, set in slots in the posts, form a crack-proof wall







One way to prevent breaks in the parapet wall is to eliminate the wall entirely. Details of steel railing developed by Voorhees, Walker, Foley and Smith, architects, for East River Housing Project

Fig. 80.

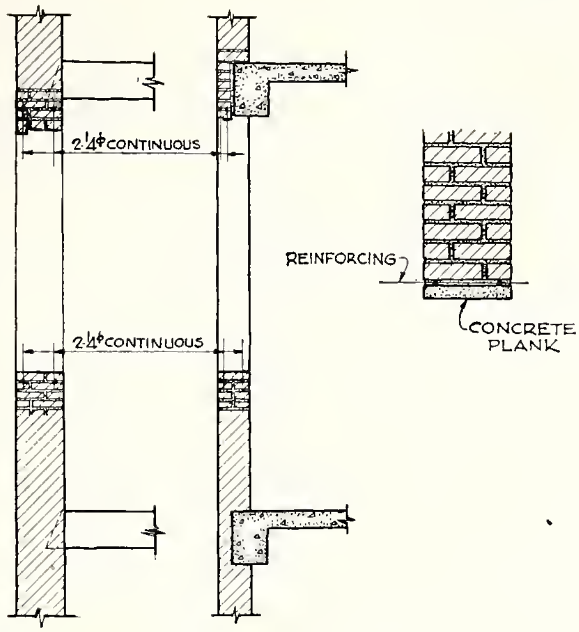


Fig. 81.

ment in the joints would cause spalling of the mortar, but he did allow us to reinforce two buildings as an experiment. One was reinforced fully, according to our standards, and the other only partially. This very interesting full scale experiment convinced us more than ever that we were on the right track. Numerous cracks were found in the unreinforced buildings just where anticipated but the one building that we fully reinforced came through with flying colors although it had been selected because of its length and severity of exposure.

Reinforced Brickwood

Your attention is called to the details shown on sketch 73 for reinforcement recommended where columns are placed 5″ away from the outside in ordinary masonry construction. Not only under these circumstances, but also generally it is well to have in mind that also in brickwork, reinforcement is very efficient where great changes of sections occur. Some examples of reinforced brickwork are shown in Fig. 81. While we are on this subject, we show an interesting little lintel detail that we used during the war to save steel lintels. It consists of concrete planks with lintel reinforcement in the joint above, between the plank and the brickwork. Such a lintel serves also to reinforce the brickwork against cracks, if the reinforcement is made continuous.

Concrete Walls

In connection with Fig. 55 we mentioned how important it is to "bind" the edge of the floor and roof plate. This principle holds also for the edges of concrete walls, particularly the tops. Take a foundation wall, for instance, resting on the ground. The ground itself, or the friction between the ground and the wall, mitigates against cracks opening at the bottom. Not so at the top of the wall. The most vulnerable period for reinforced concrete is when it has just become hard enough to carry stresses for long distances, but still weak enough to have a low tensile value. This top edge being free against the air is very vulnerable during this setting period. So even before the construction above the wall is built it is very likely that numerous shrinkage cracks have entered the wall at the edge.

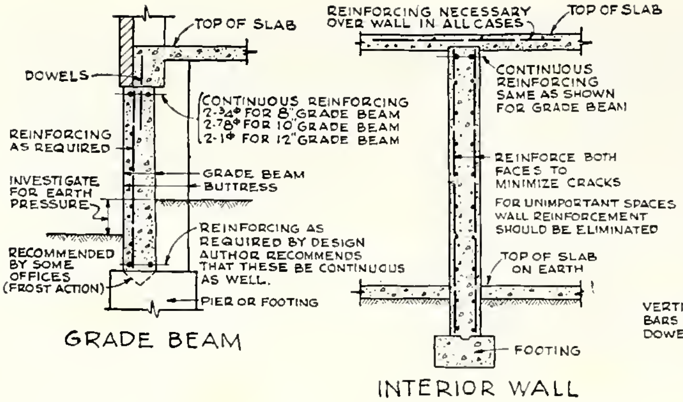
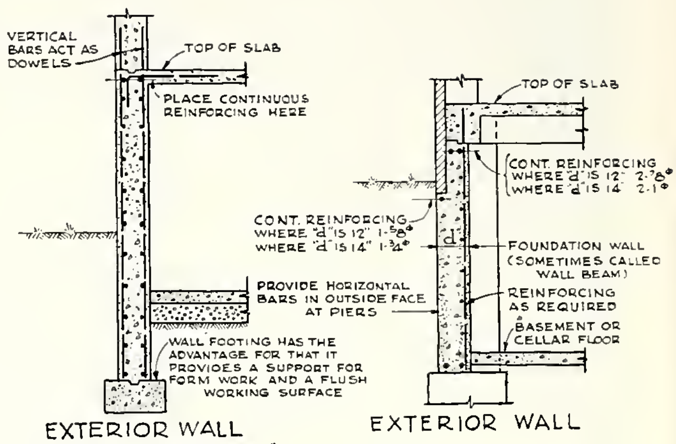


Fig. 83



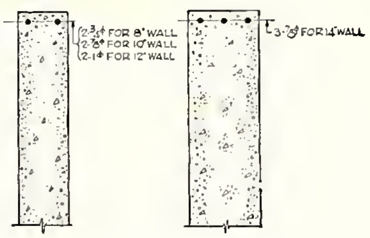


Fig. 82.

In concrete poured on the site it is impossible to eliminate shrinkage cracks. The trick is to make them invisible and so finely distributed that they will not, as the years go by, lead to large concentrated cracks. The minimum top reinforcement for various thickness of walls is shown in Fig. 82.

Our usual type of foundation walls is an 8″ "wall beam," spanning between the columns. Since most apartment house constructions are skeleton frame, all the load that these foundation walls carry is one story of masonry, the first floor loads, and the earth pressure. Very often the basements are only partially excavated with pipe spaces for the rest. Figure 83 shows various typical wall sections both for pipe spaces and where basements occur. **Insert**

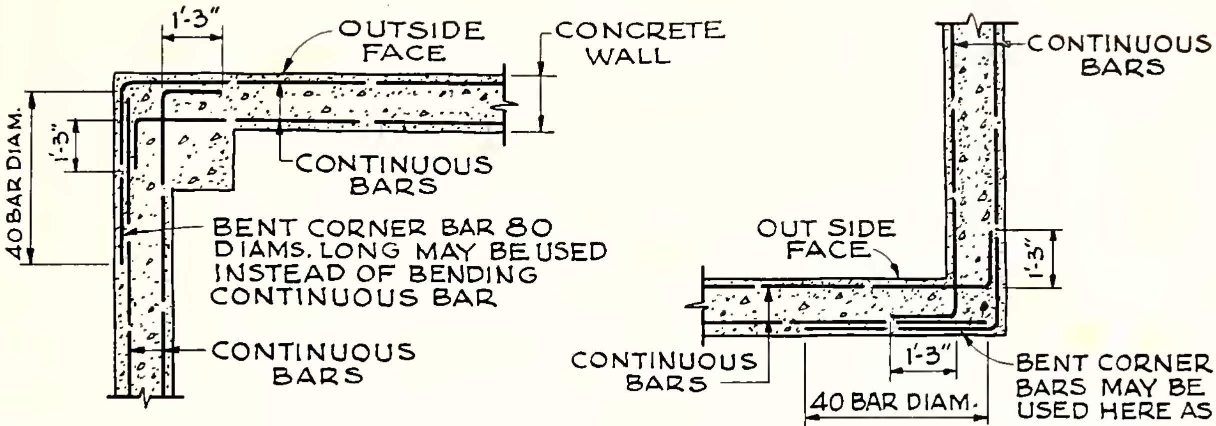
The schedule of operations in connection with back filling against the foundation walls must be very carefully studied. Often it is necessary to provide temporary supports so that the back filling can proceed before the first floor is in place. If a separate foundation contract is let, then the removal of these temporary braces must be accurately specified. By whom? Who gets them?

Where the basement is set in clay or rock excavation, it is very important to provide the proper footing drains. The clay or the rock together with the foundation wall creates a perfect swimming pool, and if not properly drained, so will your basement.

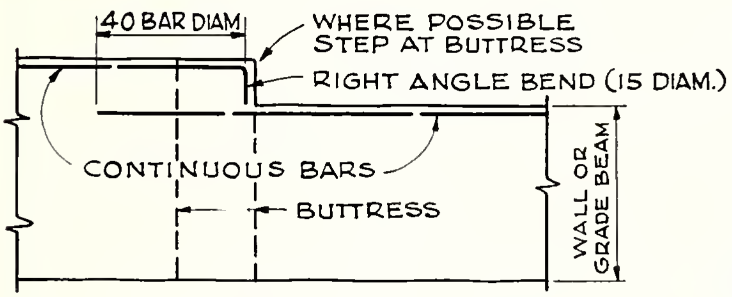
In connection with incidental bars in and foundation walls Fig. 84 shows a few details that have met the approval of building departments and contractors.

Wherever it is practical, we recommend that the corners of openings be rounded or at least chamfered. The rounding of a corner is very efficient in distributing cracks so finely around the corners that they are invisible. The reason that these

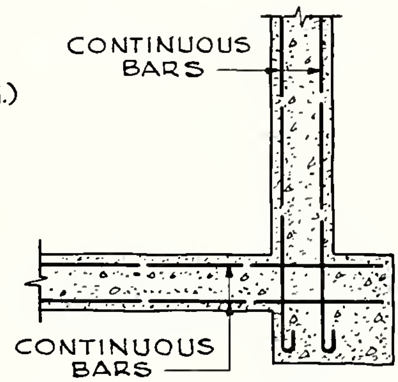
Fig. 84.



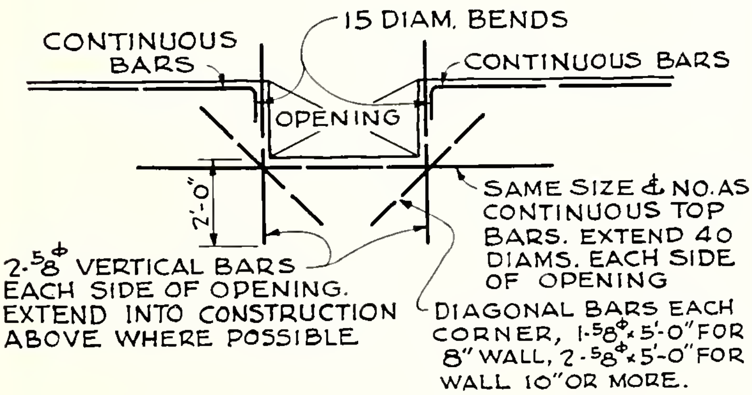
DETAIL AT EXTERIOR CORNER



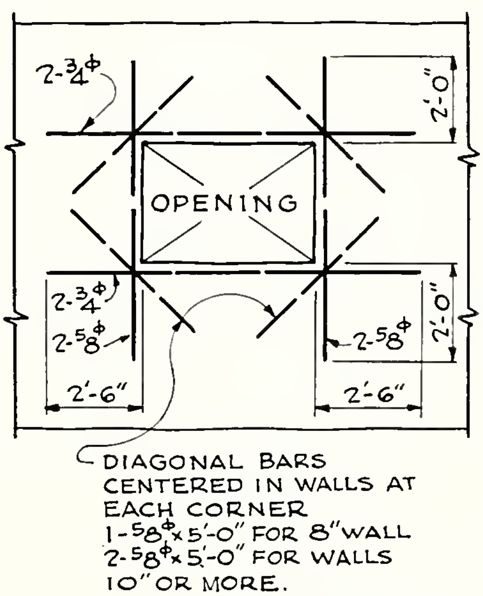
ELEVATION SHOWING STEP IN TOP OF FOUNDATION WALL OR GRADE BEAM



DETAILS AT REENTRANT CORNER

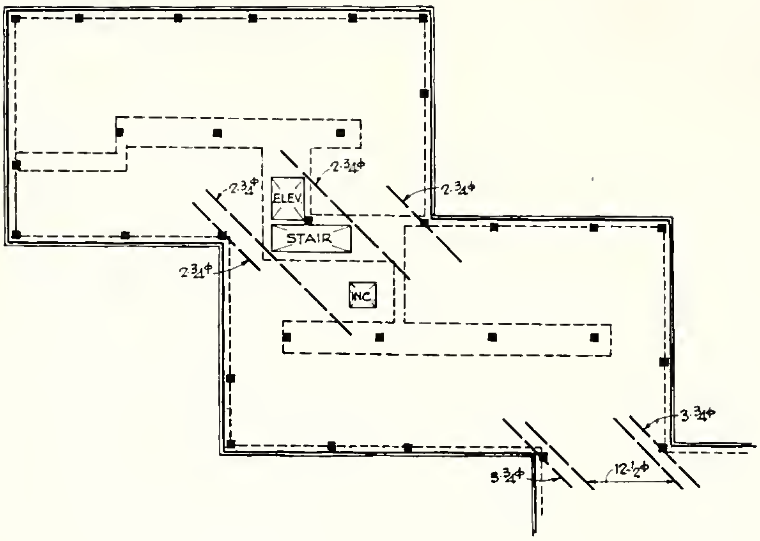


ELEVATION SHOWING OPENING IN TOP OF WALL



ELEVATION SHOWING TYPICAL OPENING IN WALL

Fig. 85.



corners are particularly vulnerable is that the formwork forming the openings restrain the shrinkage of the concrete, and as a result puts the form in compression and the concrete in tension.

Deflections

Lintels of large openings carrying narrow bands of masonry, such as over store windows, must be carefully analyzed to see that the deflection of the lintel does not exceed the permissible deflection of the masonry band, analyzed as a beam. Since the two must travel together, a permissible deflection of a steel or concrete lintel is far in excess of what the masonry can stand without cracking.

Another point that should be borne in mind is that concrete beams on long spans with heavy bottom reinforcement have a large "shrinkage deflection." This is caused by the fact that the unreinforced top fibers near the middle of the span are unrestrained against shrinkage whereas the bottom fibers shrink much less, due to all the reinforcement around them, which does not shrink. It is sometimes necessary to introduce special reinforcement at the top also, in the center of the beam, to correct this condition. A shrinkage deformation is not objectionable from a structural standpoint since it does not impair the strength of the member, but if rigid partitions are supported, it may be the cause of seeing daylight between the base of the partition and the top of the beam.

Floor and Roof Plates

A study must be made of the over-all configuration of the floor and roof plates, with their openings, to determine where additional reinforcement is required. As a guide, the resistence of the columns below the plate acting as cantilevers from the floor below to restrain shrinkage, can be used. Allowance must be made for the tensile deformation of the plate itself. In Fig. 85 is shown a project that required very careful attention in this respect due to the greatly constricted sections and torsional eccentricities.

PART 3: Heating, Elevators, Landscaping.

CHAPTER 1: Heating and Air Conditioning

BY CLIFFORD STROCK, Editor, Heating and Ventilating

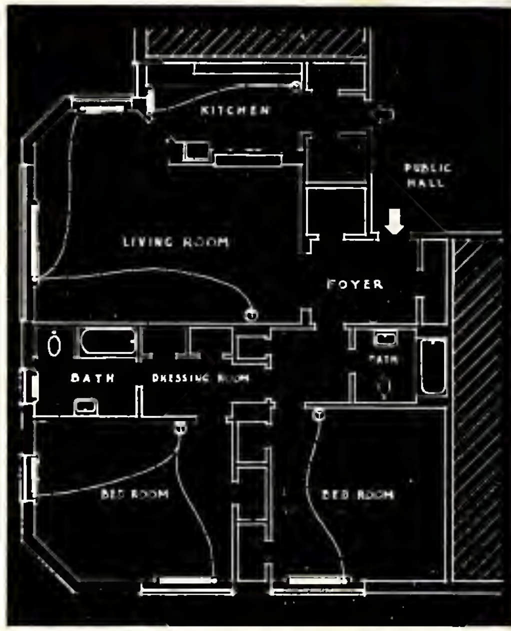


Fig. 1. Each room of each apartment has its own thermostat and radiator control valve(s). Minneapolis-Honeywell.

Heating Systems

Discussion of and selection of systems for heating and air conditioning of apartment houses are complicated by the wide variety of (a) apartment building types, and (b) climates in the U.S. This country has every variety of climate excepting completely tropical and completely polar, with consequent emphasis on cooling at one extreme and on heating at the other, and with large and populous areas between where both are important. Apartment buildings range all the way from the large multi-story projects found in the larger cities to the low and rambling garden types in suburbs; the former presents to a great extent a problem similar to those of large hotels and offices while the latter in many respects approach the single-family house in so far as the character of the heating and air conditioning is concerned. In the multi-story type, construction is heavy with low heat losses, heat capacity of the structure is high, and space is valuable; in garden type projects the construction is light and space not so much of a consideration. In multi-story buildings, heat distribution is usually (but not always) limited to steam or water; in the latter, warm air frequently can be employed.

Apartment house design, far more than with the residence, is influenced by economics. A fuel such as gas may be selected for a house even though it costs more than coal. Since the purpose of the apartment is to provide a return on the investment, the over-all fuel cost must be carefully weighed; obviously, the rate of rental and socio-economic status of the tenant enter into the equation. Consequently, economics will be kept in the foreground throughout in this discussion.

Steam Systems

While no particular system or type of system is universally approved for apartment application, steam systems of one kind or another have been more widely used than others. For smaller buildings and in garden type developments hot water can be employed, but this medium has some disadvantages in larger structures. Similarly, warm air systems are ordinarily out of the question in larger buildings for two

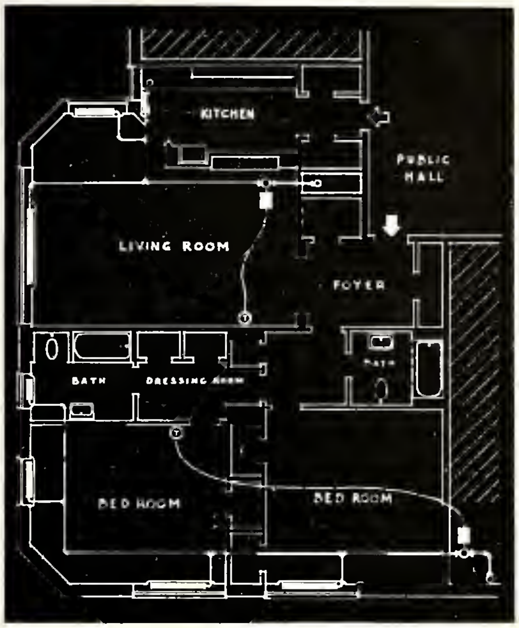


Fig. 2. Each apartment is subdivided into sections, each of which has its own thermostat and valve. In this case there are two sections—sleeping quarters and living quarters. Desirable for apartments over five or six rooms.

reasons: First, recirculation is impractical because of the undesirability of mixing air from one apartment to another. Second, the large ducts necessary for warm air distribution are too space consuming.

There is one important and modern exception to the foregoing statement. Warm air has been successfully used in a number of apartments varying in rental from low to high cost. In each dwelling unit, a small utility room, centrally located, contains a gas-fired warm air furnace vertical or horizontal in design so as to occupy a minimum of space. From this unit short ducts are run to the adjacent rooms. A peculiar advantage of this method of heating is that each tenant's unit can operate on his own meter and thus the tenant can pay for his own heating, and maintain the temperature he desires at his own cost.

A second, but at least presently relatively minor exception is a similar adaptation of steam or hot water unit heaters from which ducts are run and to which steam or water is piped. It is believed, however, that this application has been confined so far to low cost housing.

Steam supplies its own motive power and obviously carries far more heat per pound than air or water. The variety of arrangements using steam and taking advantage of the points in favor of this medium is wide, and applications to apartment buildings have been exceptionally large.

Textbooks and handbooks adequately describe the differences among such variants of steam systems as one- and two-pipe, upfeed and downfeed, vapor and vacuum systems. Not so fully treated is the *control* of steam; it is in the automatic control of steam to meet desired or required conditions that the most significant developments have been made during recent years.

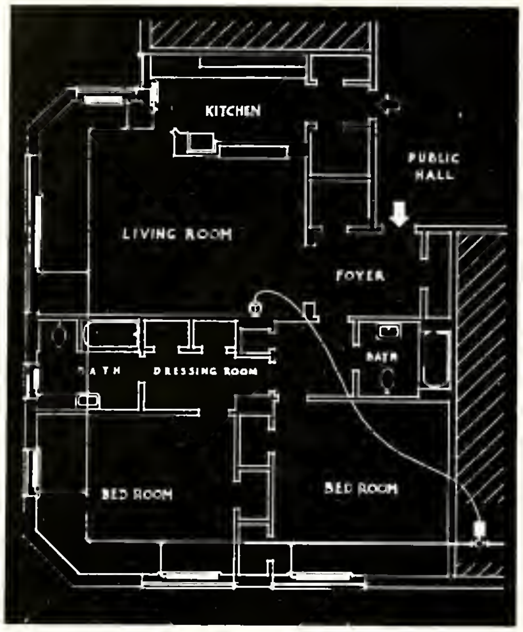


Fig. 3. Each apartment or dwelling unit is controlled by one valve under direction of one thermostat. Steam or water to all radiators in the apartment passes through the one valve.

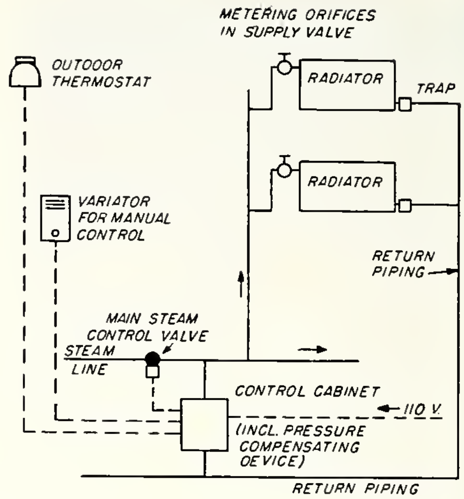


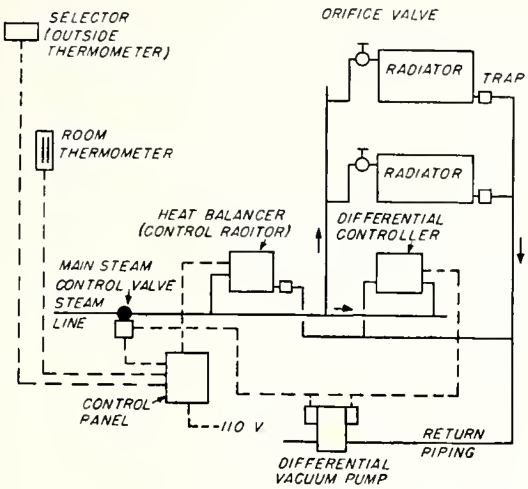
Fig. 4. Diagram of Webster Moderator system (entirely schematic). Dotted lines are electrical.

One method (Fig. 1) of meeting the variable requirements of apartments is to install an electrically- or pneumatically-operated valve on each radiator (or damper on each convector) under the control of a thermostat in that room. An alternate method (Fig. 2) is to sectionalize each dwelling unit, with a motorized valve on each main or branch serving a section of the dwelling unit; that is, with a valve on the supply main serving the living area, another on the main serving the sleeping area. A third method (Fig. 3) would be to have one such valve for each dwelling unit. The valves can be either of the on-or-off (two position) type or of the modulating type.

Any of the foregoing three so-called Personalized methods just described give the occupants complete control of conditions within their apartment and, since the desires of those in one apartment may and usually do differ from those in other apartments, will enable the tenants to obtain just about what they wish in air temperature. These methods are, however, relatively costly and primarily adapted to deluxe projects.

An entirely different approach to the problem is that of the Moderator system (Fig. 4). This differs from the foregoing Personalized controls in at least two basic respects: First, it is a complete system and includes control as part of its function, whereas, broadly speaking, the previous methods were controls independent of the system. Second, this system does not attempt to produce individual apartment control but does vary, by outside thermostat control, the flow of steam to the heating system as a whole or to zones depending on demand due to change in heat loss. Steam flow is continuous, but throttled by a motor-operated valve controlled by the outside thermostat. Manual control by the operator modifies the automatic control during heating up periods, changes in occupancy or shifts in weather other than temperature. Radiator orifices balance the system, and a mercury tube arrange-

Fig. 5. Diagram of Dunham Differential Vacuum System (entirely schematic) Dotted lines are electrical.



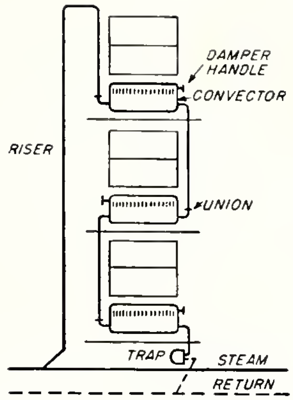


Fig. 6. Dunham Metro system for housing projects. Other parts of system (vacuum pump, etc.) similar to Differential System.

ment adjusts for changes in boiler pressure or vacuum. If the project is large, or if zoning is necessary, more than one motorized valve may be used with additional outdoor thermostats as required. This system produces predetermined conditions economically and at not too high first cost.

A modification of the original Moderator system is one intended for small or medium size buildings, and is of the pulsating flow type. It consists of the outdoor thermostat, manual control for exceptional conditions, and a pressure difference controller. This equipment operates to start and stop the automatic firing device. The pressure difference controller maintains the correct balance between supply and return piping.

Still another system, the Differential system (Fig. 5), is strictly a vacuum system and, operating under the control of an outside thermostat, meets changing outside temperatures by varying the vacuum in the system. The greater the vacuum in the system, the lower the heat emission from the radiator; consequently, the vacuum is varied from 0 to 25 inches depending on the severity of the outside temperature.

A variant of this system intended for apartments, designated as the Metro system (Fig. 6), is a downfeed system with the downfeed riser alternating from one side of a vertical series of windows to the other, the offset being part of a finned-surface convector and with the riser trapped only at the bottom. The heat from each convector is varied manually by damper (in the air stream) adjustment.

There are probably many more existing apartment buildings operating today with only manual control by the operator than are controlled by any or all of the foregoing methods. This is by no means in favor of manual control, which is ordinarily exceedingly wasteful in fuel consumption. It can be demonstrated that important savings result from proper control and the designer must weigh the cost of the con-

trol to be adopted against the type of tenant and revenue involved and probable savings. High income producing tenants may demand the highly selective type of control; economy seems to dictate the system type control.

Hot Water Systems

Conditions with hot water can be controlled either by varying the quantity supplied to the radiators or the temperature. The quantity can be varied by using pulsating flow or throttling, the temperature by by-passing the boiler and mixing supply with return water. An advantage of hot water is that it can be advantageously employed with radiant heating; steam—up-to-date—has not been.

Radiant Heating

Radiant heating using hot water has been applied to apartment houses with successful results, but care must be taken to insure that heat transmission through floors, walls, or ceilings from one apartment to another is not sufficient to create any annoyance to other tenants. Floor or ceiling panels may be used, providing sufficient insulating material is used to prevent any appreciable heat transmission from floor to ceiling, and vice versa.

Since some tenants may require cool bedrooms while others prefer some heat in all rooms throughout the winter, piping to each room should be valved and in addition a permanently adjusted modulating valve provided, so that any tenant may control the heat to his or her requirements.

It is an advantage to maintain a continuous circulation with all radiant heat installations, but this is even more desirable in an apartment house where some tenants may require heat at all times.

Many successful radiant heat installations are in operation using metal panels on the walls under windows, or in recesses flush with the wall surface. These can be connected exactly as cast iron radiators and treated in the same way. The circulating water in these cases is maintained at a much higher temperature than when the pipes are buried in plaster or concrete.

Baseboard heating can also be used with good results, providing sufficient surface can be provided in each room without having to raise the surface temperature too high.

It is very necessary to see that the construction for panel coils is such that the same temperature water is required in all panels; otherwise two or more circuits must be provided. For instance, if ceiling coils are used, the maximum temperature of the water may be in the neighborhood of 130 degrees, whereas if floor coils embedded in concrete are used, the temperature may be 20 degrees lower. On the other hand, if pipes are installed in air spaces below a hardwood floor, it may be necessary to raise the water temperature to 160 degrees or even higher to obtain the required amount of heat.

If floor heating is provided it must be remembered that some tenants may cover all floors with thick carpets, whereas other tenants may use a few scatter rugs only.

The system should be sufficiently flexible and adjustable to meet any of these conditions.

Although it is not radiant or panel heating, snow melting systems are quite similar

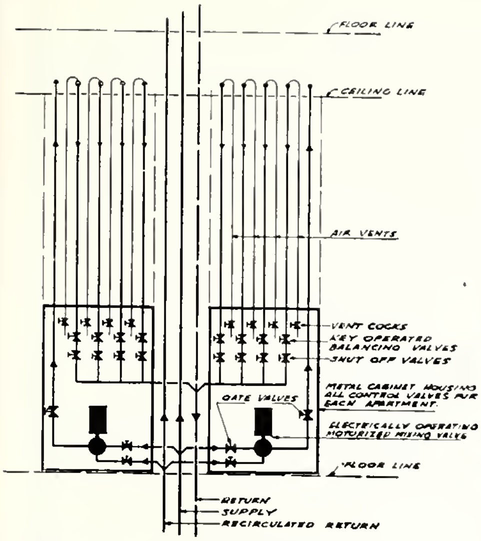


DIAGRAM OF TYPICAL DISTRIBUTION & CONTROL PANELS FOR EACH WING

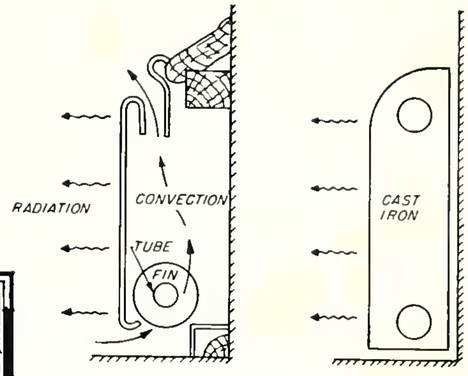
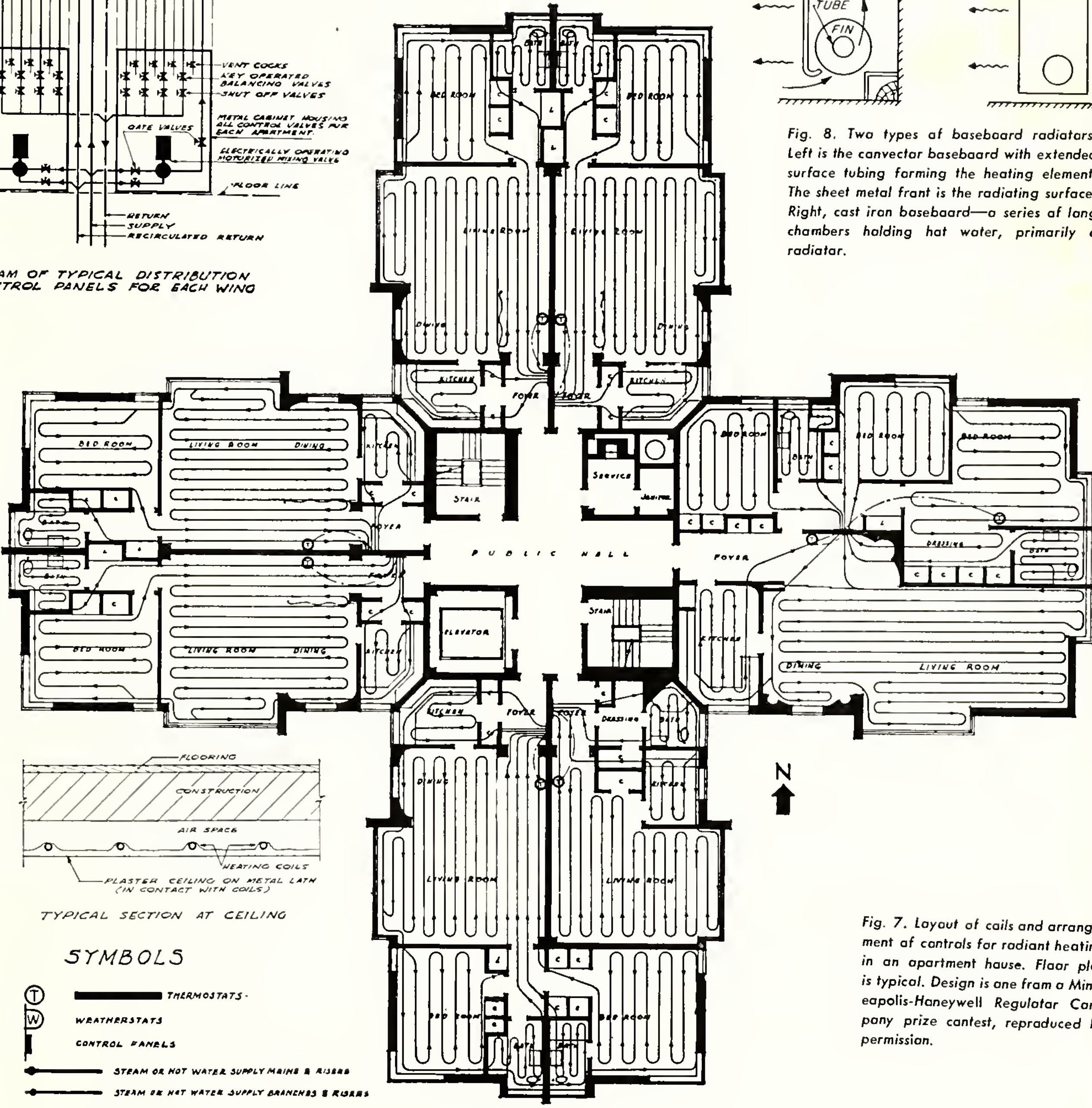
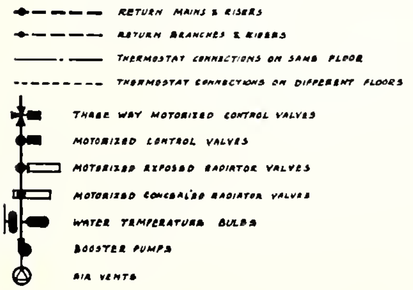


Fig. 8. Two types of baseboard radiators. Left is the convector baseboard with extended surface tubing forming the heating element. The sheet metal front is the radiating surface. Right, cast iron baseboard—a series of long chambers holding hot water, primarily a radiator.



TYPICAL SECTION AT CEILING



TYPICAL FLOOR PLAN

Fig. 7. Layout of coils and arrangement of controls for radiant heating in an apartment house. Floor plan is typical. Design is one from a Minneapolis-Honeywell Regulator Company prize contest, reproduced by permission.

in many respects, and this subject is one worth consideration in apartment projects. There is not only the advantage of keeping the walks and driveways clear even while snow is falling, but in congested areas, where there is no place to pile the snow, a snow melting system can be a great asset. Another application is on open steps.

It appears that there may be great possibilities in combining radiant and convection heating. To date, advocates of one or the other are in opposition. There is, however, merit in both, and the eventual result may very well be a compromise of some sort yielding the advantages of each.

Central Heating

To avoid confusion of terms, central heating referred to here is a heating plant serving more than one building, and not in the British sense of a central heat source for one building. With group projects the architect and his engineer are faced with the selection of three possible arrangements: (1) a heating plant for each building; (2) a plant serving a group, but not all, of the buildings, and (3) one central system for the whole project.

Topography and site layout have a great bearing on the choice among these three. By and large, though, method (2) is not so desirable as one central plant, except where it is not possible to cross streets with heating lines due to presence of other utilities or impossibility of obtaining right-of-way. Both first cost of plant and operating cost are in the order given, in most cases. Consequently, the logical starting point for group project heating design is the one central system.

When central heating is contemplated, careful cooperation is desirable on one point frequently overlooked: The cost of underground central heating lines is greatly increased if streets are curved, as compared with that where the streets are laid out straight. The desirability of curved streets may be worth additional heating expense, but this should be recognized in advance by those planning the general arrangement.

Distribution Lines

Underground piping should be installed in a simple conduit consisting either of split-tile, built-up tile, pre-cast lightweight concrete with a continuous concrete base and gravel backing where required, sponge-felt asbestos pipe covering with integral waterproof jacket, or of a system of presealed conduit with metal outside casing insulated with a sectional covering. However, all types of conduit should be given full consideration.

Design of the distribution lines should not be deferred until after the site plan has become set. Both the character and extent of the distribution system may be influenced by close cooperation between the heating engineer and the site planner from the beginning.

Buildings arranged compactly will achieve economy in heating distribution. Where plenty of land is available, it is more economical to concentrate the area not needed for housing in a single large unit than to space the building widely over the entire site.

An investigation should be made of soil conditions for the bearing value before the design of any underground distribution system has been started. Particularly is this true when the project site is filled ground or on a city dump.

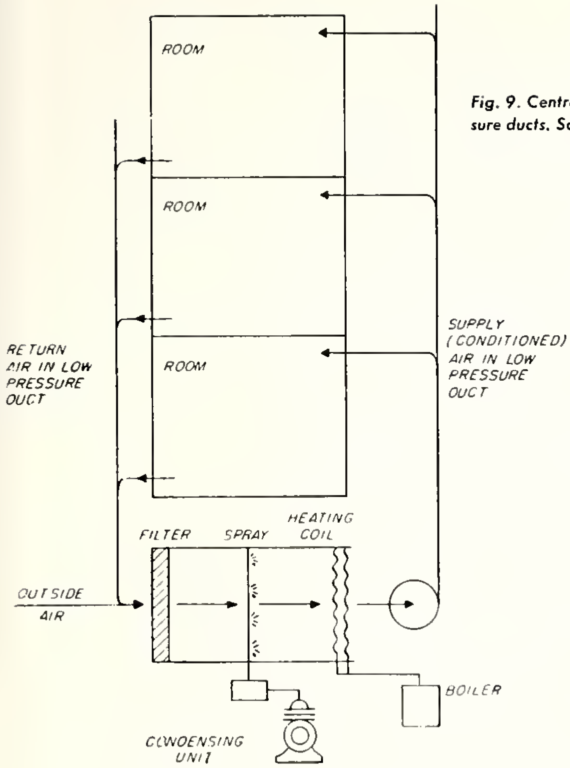


Fig. 9. Central duct system with large low pressure ducts. Schematic.

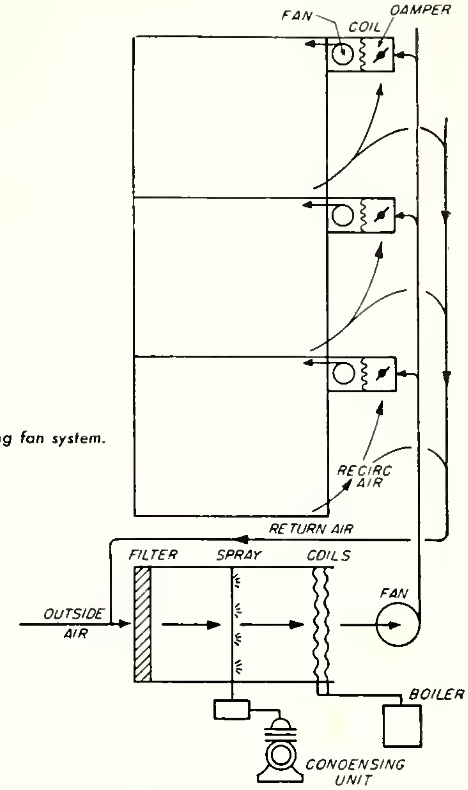


Fig. 10. Recirculating fan system.

It is desirable to reduce the number of steam drip traps located in yard steam manholes to a minimum, and wherever possible provide for dripping yard steam mains by traps placed inside the nearest basement. If possible, keep traps out of manholes.

Air Conditioning

In spite of codes, resolutions, and many attempts to define air conditioning, this term still means cooling to most people, and is so intended here. In the deep south, the southwest, and in the hot zone through Missouri, Kansas, Oklahoma, and Texas, cooling is at times almost a necessity; in many other sections it is certainly highly desirable, and in the humid belts along the coast or near the Great Lakes it is not entirely a luxury.

Almost any type of cooling can be adapted to garden type apartments, including the relatively new gas-fired absorption systems and the still newer heat pumps. For the multi-story large project, however, these systems are usually out of the question in most sections of the country, but even so there is such a wide variety of systems and equipments in such numerous combinations as to make a selection difficult. Omitting a number of sub-classifications we can group the usual methods roughly under six general types as follows:

1. The conventional **central duct system** (Fig. 9) with well water or mechanical refrigeration in one apparatus room, from which the cool air is distributed by low pressure ducts. Generally the ducts will occupy so much valuable space that in high cost urban locations such a system may be out of the question. Another disadvantage is that rather complex arrangement of mixing dampers, ducts, and fans may be necessary if individual control of temperature is desired for each apartment. However, if space is available, and if the system is carefully zoned, it can be (and has been) highly satisfactory. More flexibility, better control, and use of smaller ducts is attained by a variant of the central duct system employing recirculating

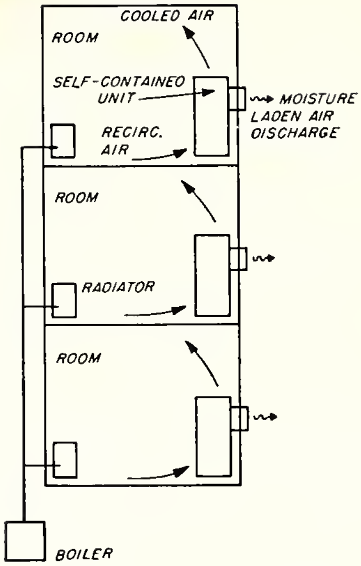


Fig. 11. Self-contained units with fan, filter, condensing unit and coils. Moisture from air discharged to outside. Schematic.

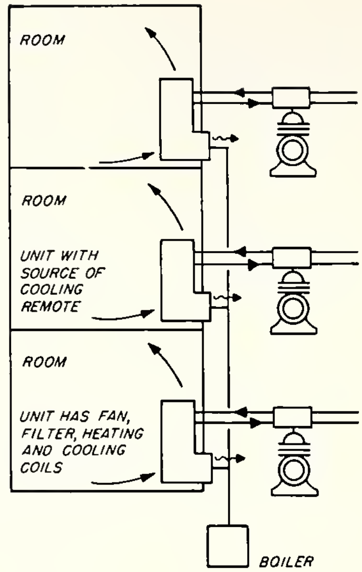


Fig. 12. Unit system with ventilating type units connected to remote sources of heating and cooling.

fans. A unit containing fan, coil, and mixing damper is used outside the space to be conditioned, and supplied with conditioned air from the central units (Fig. 10). Recirculating air in ratio desired is induced into unit, giving accurate temperature control. The coil may be used to heat in one portion while cooling is required in an adjacent area.

2. At the other extreme is the **self-contained room cooling unit** (Fig. 11), one or more in each apartment, and with each unit having its own refrigerating compressor, filter, and fan. The water condensed on the coils can be carried to the outside air in an air stream. Advantages are (a) that these can be installed only in apartments where desired (for example, where tenant will pay extra for this feature); (b) the complete control occupant has over the temperature in his apartment; (c) the non-dependence of one unit on another; (d) the fact that air is not recirculated to other apartments, thus avoiding spread of odors, dust, or bacteria from one apartment to another, and (e) the ability of such an arrangement to provide heat (from a central system) to one apartment while another is being cooled—a not infrequent requirement because of sun and shade, variation in metabolism among individuals, etc. Disadvantages include (a) presence of so much machinery in each apartment; (b) consequent high over-all maintenance; (c) lack of control over humidity, since dehumidifying is only a by-product of the cooling. This method requires a separate heating system for winter, excepting in those rare cases where heating is infrequent and can be provided by electric units.

3. The **unit type** (Fig. 12) with **remotely located source of cooling**. There are a rather wide variety of these with different characteristics, and since the source of cooling is remote the source of heat can also be remote and, consequently, these units can almost always be provided either with (a) separate coils for heating, or (b) use of cooling coils for heating, so that no separate radiators are required. Chilled

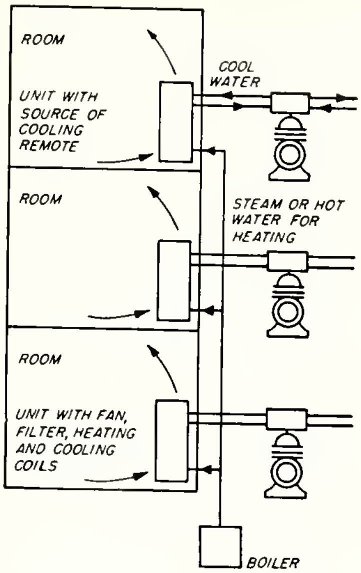


Fig. 13. Unit system with recirculating units connected to remote sources of cooling and heating.

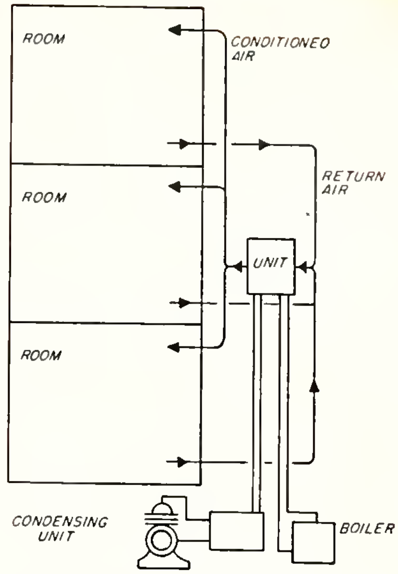


Fig. 14. Central source of cooling and heating supplies units, each serving a number of rooms or apartments. Each unit contains fan, filter, and coils, distributes conditioned air through ducts to adjacent spaces.

water and hot water connections are to a central boiler for heat and either to a central cooling plant or to a nearby apparatus room for cooling. In the latter case, there could be, if desired, one refrigerating compressor and other equipment for each apartment, or each floor, or each zone.

Recirculating Remote-cooling Type

Probably the simplest device of this type contains coils, fan, and filter, with air entirely recirculated (Fig. 13). Advantages are (a) relatively low price; (b) relative simplicity of system; (c) no mixing of air from one apartment to another; (d) where a number of apparatus rooms are provided for zoning, reasonably good likelihood of cooling in one apartment, heating in another; and (e) individual control of both heating and cooling.

Disadvantages are (a) no control of summer humidity; (b) rather high maintenance due to multiplicity of machinery; (c) necessity of draining moisture condensed on coils in summer; (d) probable build-up of odors and smoke in room since all air is recirculated.

Ventilating Remote-cooling Type

Generally similar to the foregoing is a unit with connections to the outside air to provide an inlet for ventilating air. This has the advantages of the recirculating unit plus some of its own. A disadvantage is that the outside wall must be cut; on the other hand the advantage of ventilation probably offsets this.

4. Since the disadvantage of the central duct system is duct space required, but since it can be quite satisfactory if zoned, this suggests a **combination of central and unit system** in which refrigeration and boiler equipment centrally located supply hot and chilled water to units located either (1) one on each floor or two floors, (2) one for each zone, or (3) even one for each apartment (if large). The units contain coils, fan, and filters, and from them individual ducts are run to each of the

important rooms. Advantages are (a) removal of machinery from apartments; (b) relatively low maintenance; (c) flexibility regarding zone. Occupants have reasonable but not absolute control over temperature. Disadvantages include (a) ductwork required; (b) inability to heat one apartment, cool another simultaneously if in the same zone.

5. Similar to (4) is the possibility of employing in each apartment a complete year-round gas unit, using absorption refrigeration for which gas is the energy source. This system would require no chilled and hot water pipes from the central plant to the units, would require a gas line and stack connections to and at each unit. The cost of gas would determine to a considerable extent the advisability of such a system.

6. There are two proprietary systems intended especially for multi-story buildings.

Carrier System

Features of this system (Fig. 15) can be summarized under three points. First, the dewpoint of the air is controlled in a basement (or apparatus room) conditioner; at the same time the air is cleaned and humidified, if necessary. Second, this air is distributed to the rooms to be conditioned through small diameter conduits at a relatively high pressure and high velocity. Third, at the room unit the high pressure air passes through an injector arrangement inducing a flow of room air over cold or hot water coils, depending on the season, supplied from the basement or apparatus room. There are no return air ducts since only the ventilation air is brought into the room and a quantity equal to this amount is allowed to leak from the room to be picked up by a corridor exhaust system.

The room unit receives the primary or high pressure conditioned air at its base. This air passes around sound absorption baffles in a plenum chamber and is ejected from nozzles at high velocities. This induces a flow of secondary air from the room into the unit through a grille in the front of the room unit and over the heat transfer coils through which hot water is circulated during the heating season and chilled water during the cooling season. The velocity of the primary air leaving the nozzles is such that the secondary and primary air are thoroughly mixed when they leave the top of the unit. The quantity of primary air supplied, which is equivalent to the amount of ventilation air needed, is constant. The room temperature is regulated by the action of a thermostat in the room on a valve controlling the quantity of hot or cold water allowed to circulate through the coils. This valve is operated either automatically or manually.

It is important to note that excepting under unusual conditions there is no dehumidifying taking place in the room unit, no filtering, and no humidifying. The room unit controls only the dry bulb temperature.

The conduit is a steel tubing fabricated in the factory to floor-to-floor lengths and rust-proofed. Fittings and branch connections are standardized so that all risers and connections require no sheet metal fabrication, but are assembled on the job. These risers and connections are slipped together like fishing rods. Ordinarily the largest pipe size is 6½ inches and this will usually take care of from 12 to 15 floors from one riser. Such conduits can be placed together with the water piping, in the usual pilasters without any enlargement. The connection from the risers to the room units are flexible to allow for expansion, contraction, and ease of adaptation, and

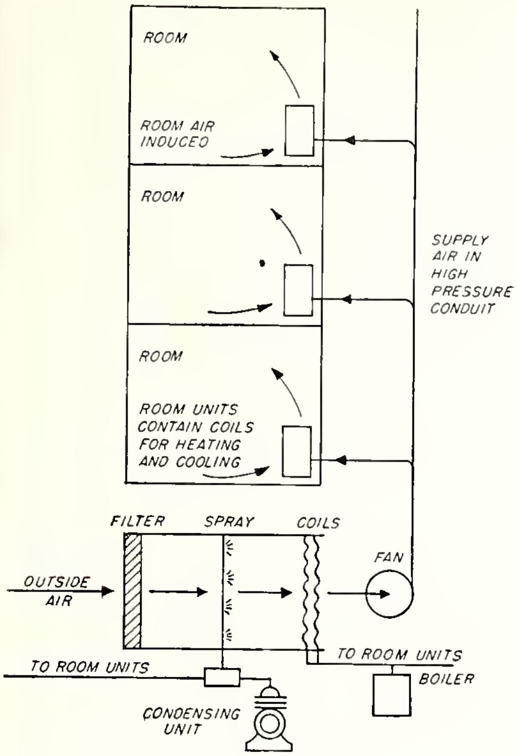


Fig. 15. Carrier conduit system.

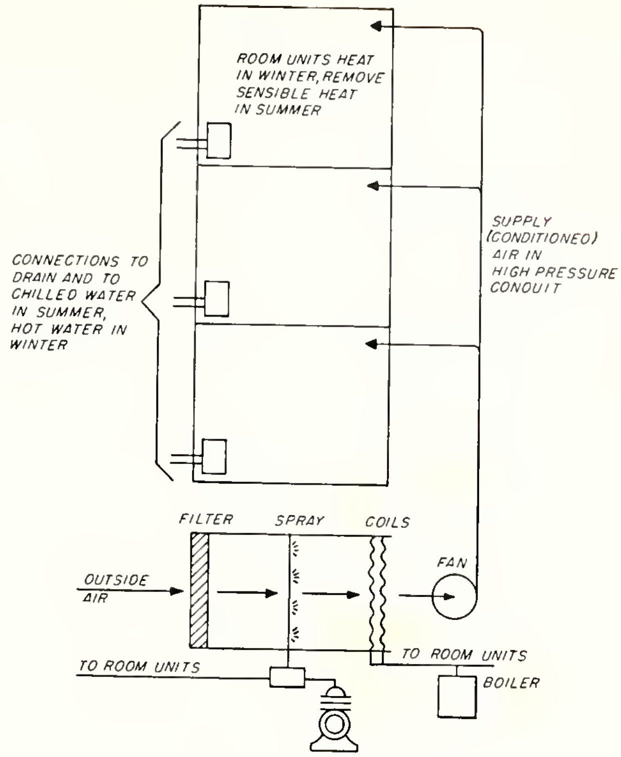


Fig. 16. Trane custom air system.

are 3 inches in diameter so that they can be concealed in a metal baseboard, or in new buildings may be recessed back of the furring.

Air flows through the conduit at pressures ranging as high as 8 inches of water and at high velocities. The power consumption, however, is said to be much less than with conventional systems since (1) the air does not have to be returned, and (2) only ventilation air is being handled.

Important advantages claimed for this system include the following:

Space Saving. The conduit system, with its small supply piping and no return duct, is said to use only 15% as much space as the conventional duct system. Consequently, where space is rentable or useable, particularly in large or tall buildings, this becomes an important feature.

Simplicity of Installation. This advantage is claimed because of the reported ease of installing the conduit, the absence of return grilles and return ducts, and the absence of machinery in the room units scattered throughout the building.

Lack of Odors. Since no dehumidification takes place in the room unit, odors resulting from the collection of water in drip pans are not present.

Flexibility and Uniformity. The zoning accounts for flexibility of temperature control which, it is claimed, can result in a considerable saving in fuel costs. Uniformity results from the fact that humidity is controlled at a central apparatus in such a way that air conditioning and ventilation are independent of the temperature control.

Trane System

This system (Fig. 16) consists of two basic parts: (1) Room units containing fan,

filter, and cooling and heating coils, for heating in winter and removing sensible heat in summer. (2) A central ventilating system which supplies ventilating air in winter and dehumidified air in summer through either low pressure ducts if space is available or through high-pressure conduits if space is scarce.

In winter, hot water is supplied to the room units from a steam-to-water heat exchanger.

The quantity of water flowing through the coil of each unit is controlled by an individual room thermostat. Ventilation air is separately introduced at or near room temperature. Humidity is added by the sprays in the ventilation air equipment.

Between seasons, as the outdoor temperature rises the temperature of the water, circulated to the room units is gradually reduced. The temperature of the ventilation air is not reduced until the outdoor temperature reaches 75°F at which time the ventilation air is reduced to its cooling minimum, usually 60°F. At this time the water flowing to the room units will still be warm enough to provide some heat if necessary. As the outdoor temperature rises the water circulated to the room units will be gradually chilled until full cooling capacity is available. On falling temperature this cycle is reversed.

In summer, chilled water is supplied to the room units where the quantity of water flowing through each unit is controlled by the room thermostat. The room units remove sensible heat only. Ventilation air is introduced separately at a predetermined minimum temperature. Dehumidification in the room space is accomplished by the dehumidified ventilation air.

Advantages claimed for this system include: (1) no mixing of air from apartment to apartment; (2) individual apartment control over conditions; (3) dehumidifying independent of sensible cooling; (4) ventilation independent of sensible cooling; (5) flexibility in regard to partitioning and adding room units.

Fuels and Fuel Estimating

Due to the importance of economics in apartment design, a detailed cost analysis for the various types of systems, various heating media, various fuels, and various heat delivery and distribution equipments is desirable. Such a study may bring out some startling and unanticipated facts; a low cost fuel, for example, may prove to be the most expensive to use when the over-all costs are analyzed.

The cost analysis should include not only the obvious items but certain more or less hidden costs, such as cost of space and facilities for fuel storage, and insulation of boiler room ceilings. In the case of the central plant, land cost for the boiler house as well as the cost of roads and railway facilities must be charged against the plant. Excavation costs for supply and return lines are somewhat hazardous to predict and should be investigated carefully.

In any comparison of fuel costs it is well to bear in mind that the cost of fuel for heating cannot be considered as an isolated item; fuel for hot water, cooking, and refrigeration in many cases must be considered at the same time, inasmuch as this inclusion or non-inclusion greatly affects the rate structure where gas or purchased steam is involved. In general, the recent increase in labor costs have more sharply increased the costs of solid fuel than of oil, gas, or purchased steam, and old analyses are obsolete.

TABLE 1. CUBIC FEET OF USEABLE SPACE PER SQUARE FOOT OF EQUIVALENT DIRECT STEAM RADIATION*

Outside Design Temp., °F	Number of Stories				
	One	Two	Three	Four	Six
+20	48	61	67	71	75
+15	46	58	63	67	70
+10	44	54	60	63	66
− 5	41	51	56	60	62
0	38	47	52	55	58
− 5	35	43	48	51	53
−10	32	41	44	47	49
−15	29	37	41	43	45
−20	26	33	37	39	42

* Figures in this table are for preliminary purposes only in preparing an economic analysis, and not for individual room calculations. An inside air temperature of 70°F is assumed.

In cases where a 24-hour labor shift is necessary, the cost per shift can usually be multiplied by 3½ to determine daily costs, the fraction allowing for relief time.

Where the cost analysis shows a difference of not more than 5% between two different methods, fuels, or systems, they can be considered as equal in cost, for cost predictions are not accurate within that limit.

Tables 1 and 2 are given here because they have not had wide distribution and appear in no handbooks so far as is known. Table 1 is for preliminary cost estimates only and not for radiator calculation, but is quite useful for the use intended. Table 2 gives factors for multiplying the first cost to determine (a) maintenance and repair costs, and (b) replacement costs. In other words, in Table 2, the annual cost of maintaining and repairing a boiler in a project of less than 300 dwelling units will be 2.25% of its installed cost, and 4.12% must be set aside each year for replacement. Both Tables 1 and 2 are from data prepared by one government agency concerned with large scale housing.

The predicting of fuel consumption is sometimes involved and can be highly inaccurate. The accompanying tables (3, 4, 5, and 6) are those used by a government housing authority and cover the three common fuels and purchased steam. The first three tables are based on 100% efficiency, and the values are to be divided by the assumed efficiency of the fuel burning device. For example, if 140,000 Btu oil is to be burned at an assumed 80% efficiency in a plant designed to maintain 70°F in −5°F weather, find, from Table 5, a factor of .00064 gal. per sq. ft. of radiation per degree day at −5°F. For 80% efficiency the factor would be $\frac{.00064}{.80} = .0008$ gal. per degree day per sq. ft. of steam radiation. For purchased steam (Table 6) no efficiency correction is necessary.

TABLE 2. MAINTENANCE AND REPAIR REPLACEMENT FACTORS*

Scheme	Items	Maintenance and Repair			
		Under 300 Dwelling Units	Over 300 Dwelling Units	Replacement at 2% Interest	Expected Life in Years
A. Central plant, high-pressure steam or forced hot water	Fuel burning equipment	0.0225	0.02	0.0412	20
	Other heating equipment	0.0225	0.02	0.0175	38
	Related items	0.0175	0.015	0.01	55
	Structures	0.0075	0.0075	......	..
B. Group plants or low-pressure steam or forced hot water central plants	Fuel burning equipment	0.0225	0.02	0.0412	20
	Other heating equipment	0.0225	0.02	0.02	35
	Related items	0.0175	0.015	0.01	55
	Structures	0.005	0.005	......	..
C. Individual building plants	Fuel burning equipment	0.0225	0.02	0.0412	20
	Other heating equipment	0.0225	0.02	0.0225	32
	Related items	0.0175	0.015	0.01	55
	Structures	0.005	0.005	......	..
D. Individual dwelling unit plant systems	Gravity warm air	0.02	0.02	0.0578	15
	Forced warm air, gas-fired	0.02	0.02	0.0209	20
	Gravity steam or hot water	0.02	0.02	0.0166	40
	Circulators	0.02	0.02	0.0913	10
	Structures	0.01	0.01	......	..
E. Domestic hot water	Heater and tank	0.0225	0.02	0.0578	15
	Generators; pumps	0.0225	0.02	0.0412	20
	Gas and water piping	0.0125	0.01	0.01	35
	Related items	0.0175	0.015	......	..

*The factors in this table are basic only; they may be varied to suit local conditions and type and quality of the heating or domestic hot water systems.

TABLE 3. FUEL FACTORS FOR USE IN ESTIMATING COAL OR COKE CONSUMPTION FOR STEAM HEATING

Heating Value Btu. per Lb.	Design Temperature, F						
	−20	−10	−5	0	+5	+10	+20
	Fuel Factor, Lb. per Sq. Ft. Radiation per Deg. Day at 100% Eff.						
11,000	.00678	.00764	.00813	.00872	.00938	.01018	.01222
12,000	.00622	.007	.00746	.008	.00862	.00933	.0112
13,000	.00574	.00646	.00689	.00738	.00795	.00862	.01034
14,000	.00532	.006	.00639	.00685	.00737	.0080	.0096

TABLE 4. FUEL FACTORS FOR USE IN ESTIMATING GAS CONSUMPTION FOR STEAM HEATING

Heating Value Btu. per Cu. Ft.	Design Temperature						
	−20	−10	−5	0	+5	+10	+20
	Fuel Factor, Cu. Ft. per Sq. Ft. Radiation per Deg. Day at 100% Eff.						
500	.14933	.168	.179	.192	.2065	.224	.2688
1,000	.07466	.084	.0896	.096	.1033	.112	.1344
1,040	.07180	.08077	.0862	.0923	.0994	.10769	.12923

TABLE 5. FUEL FACTORS FOR USE IN ESTIMATING OIL CONSUMPTION FOR STEAM HEATING

Heating Value Btu. per Gal.	Design Temperature						
	−20	−10	−5	0	+5	+10	+20
	Fuel Factor, Gal. per Sq. Ft. Radiation per Deg. Day at 100% Eff.						
140,000	.00533	.0006	.0064	.0006857	.00737	.0008	.00096
148,000	.000505	.000568	.000606	.000649	.0007	.000757	.0009081

TABLE 6. FACTORS FOR USE IN ESTIMATING PURCHASED STEAM CONSUMPTION FOR HEATING

Design Temp., F	Fuel Factor, Lb. Steam per Sq. Ft. Radiation per Deg. Day
−20	.0778
−10	.0875
− 5	.0933
0	.1000
+ 5	.1077
+10	.1167
+20	.1400

Hot Water

The steam load to be added to the boilers for generating the domestic hot water load can be estimated at 7 lb. of steam per hour per dwelling unit which will, in many cases, equal about 25% of the total equivalent direct radiation.

In the cases of multiple buildings, where the hot water generators are scattered in machine rooms throughout the project there should be added to the fuel consumption an amount to compensate for the loss of steam in the trench.

Where the hot water generators are located in the boiler plant 5% should be added to the steam consumption as a safeguard against unforeseen losses.

Boiler Room Equipment

For central heating plants, boilers should be designed to operate at 100 to 125 lb. per sq. inch gauge, with not less than three water tube boilers operating at 150% of rated capacity, or portable fire box boilers at 100% of rating. Normal rating should not exceed 500 hp except where more than four boilers are required.

Experience has shown that where three boilers are installed and operating at 150% of rated capacity, spare boilers are not required for possible breakdowns.

Provide for easy cleaning of all water and fire surfaces. Soot blowers on water-tube, horizontal return tubular, and fire-box boilers burning bituminous coal are desirable.

Easy removal of ashes should be provided for, as should a method for trapping and removal of fly ash.

A clear space of 14 feet minimum (or as much as is necessary for pulling tubes) should be allowed between boiler fronts and the wall of the building, not less than

6 feet between the rear of the boilers and the wall of the building, and not less than 6 feet between each boiler for air- and water-cooled walls, and 5 feet for all others. Each boiler should have an individual setting unless when set up in batteries of two.

Design for proper ventilation over the top of all boilers. This can best be accomplished by a monitor over each boiler with pivoted sash and extended operating device or by an installation of fans in ventilators.

Regardless of fuel selected, the boiler, breeching, and chimney should be sized for hand-fired coal burning. The experience of housing projects during oil shortages prompts the foregoing statement. During and after the conversion of oil-burning plants one government agency noted the following points:

Due to congested boiler rooms many plants could not be converted without the expenditure of large sums of money for moving equipment and in some instances it was impossible to move the equipment.

Some plants had to have induced draft-fans installed due to small chimneys and breechings that were designed for oil-burning.

Other plants had boilers sized for oil-burning in the original design and during the period from December 15 to March 1 the boiler plants had to be operated 24 hours a day. Otherwise it would have been noon before a livable temperature could have been developed in the dwelling units.

Lack of provisions for contemplated coal storage in the original design made conversions to coal burning expensive; and these lead to the conclusion that with projects designed to amortize in sixty years anything can happen to curtail the use of a given fuel.

Chimneys

Peak boiler loads should be based on a selected minimum outside temperature. Chimney diameters should be the most economical size, calculated for peak load demand at 20°F above the design temperature, with provisions for further extension if an extension to the project is anticipated in the near future. Regardless of fuel selected, design the chimney for 90% excess air under peak load demand for coal, hand-fired and with cinder trap.

Coal and Ash Handling

Traveling weigh lorries, electrically operated, should have capacities of not less than 1,200 lb. for boilers up to 250 hp, and 1,800 lb. for boilers above 250 hp, and should be equipped with switches to limit the horizontal travel. Use of this type of equipment can be limited to projects where the total annual coal consumption exceeds 3,500 tons. Chutes to stoker hoppers should be closed on all four sides to protect against coal dust.

Where the rails for the traveling lorries pass close to the front of boilers, hinged sections should be provided so that they can be swung out, thus providing space for the opening of doors for cleaning.

When the annual coal consumption is up to 2,000 tons, consideration should be given to the method of ash disposal, and when over 2,000 tons, a pneumatic or preferably a mechanical system of ash handling is desirable.

Instruments

The following instrument boards have been recommended for heating plants burning in excess of 2,500 tons annually:

(a) One main instrument board located in the boiler room as directed and having an electric clock, 6 inch diameter; smoke density indicator and recorder; recording and integrating steam flow meter, for yard distribution systems only; steam pressure gauge indicating boiler pressure; and a steam pressure gauge indicating pressure in the yard distribution system.

(b) An instrument board for each boiler, located adjacent to the boiler as directed and having a CO_2 recorder; exit gas recording pyrometer; indicating and integrating steam flow meter; steam pressure gauge furnished under boiler trimmings; and draft gauge that will comply with the draft requirements by having the requisite number of pointers.

(c) Provide one year's supply of each chart used on each instrument board.

(d) Provide portable orsat.

CHAPTER 2: Elevators

BY H. M. NUGENT AND W. H. EASTON, JR.—Otis Elevator Company

Introduction

The purpose of this chapter is to outline and discuss the fundamental considerations which influence the choice of elevator equipment for apartment buildings. The detailed solution of vertical transportation problems is a specialized art, and many architects prefer to leave these details to a reputable elevator manufacturer. Nevertheless, no architect should be completely dependent upon a manufacturer for his decisions, nor entirely ignorant of the choices which are to be made.

When Are Elevator Required?

The building laws of many localities require that apartment buildings of six stories or over have elevator service. For example, a New York State law on multiple dwellings states: "Every multiple dwelling hereafter erected exceeding in height six stories or sixty feet shall be equipped with one or more power passenger elevators operated or capable of being operated at all times, at least one of which is accessible to each apartment above the entrance floor."

This is a good law but a poor rule. Today's renting public is acutely conscious of elevator service and the era of the four-story walk-up apartment building is at an end. All apartment buildings of four stories and up should be served by elevators and many three story apartment houses are being so equipped. Whether or not elevator service should be provided in a three story building depends partly on the class of tenants involved, but the decision is also influenced by the fact that with elevators, upper floor apartments become more desirable and bring higher rents than lower floor apartments.

Traffic Flow Characteristic

The number of elevators which will be required to serve a proposed building depends upon the volume and time-distribution of the elevator traffic. Data on traffic behavior are usually obtained from traffic flow charts which are prepared by surveying the traffic flow in buildings similar to the ones under consideration. The number of passengers handled during each five minute period of the day is counted, and the results are plotted against time.

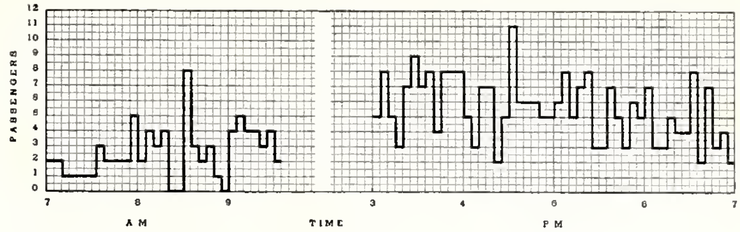


Fig. 1.

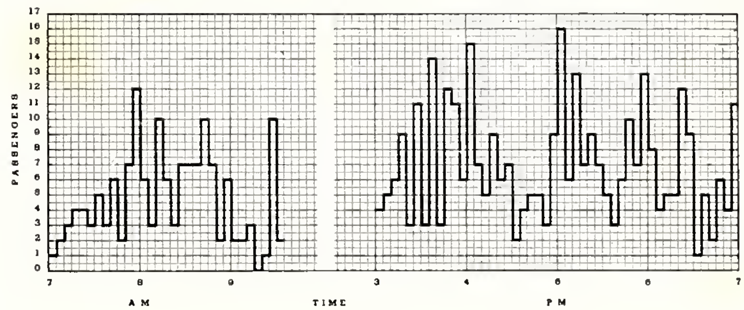


Fig. 2.

The traffic flow charts shown in Figs. 1 and 2 were made from surveys conducted in the Metropolitan Life Insurance Company's "Parkchester," Bronx, N.Y., apartment house development. Figure 1 illustrates how traffic behaves in a building unit served by one elevator, and Fig. 2 is from data collected in a two-elevator building unit. The traffic flow pattern exhibited by these charts is typical of many apartment buildings tenanted by families of medium salaried office-workers.

Apartment house elevators are usually busy throughout the day, but are not subject to the pronounced traffic peaks which are found in office buildings. There is a period of increased traffic in the morning when tenants leave for business, in the afternoon when children return from school, and in the evening when tenants return from work, but these are spread out because tenants and their children work and attend school at various distances, and at different times. Usually the evening increase is the greatest, but it seldom exceeds 6% of the building's population during any five minute period. As a result, passenger handling capacity of the elevators during peaks or maximum traffic flow periods is not the major consideration in the planning of apartment house elevators.

How Many Elevators Are Required?

One elevator will serve the 50 to 70 families of an upper-middle-class apartment house not over six stories high. In these, the single elevator handles both passenger and service requirements. High rental apartment buildings of six stories or less sometimes have a second passenger elevator or, more often, a separate service elevator, but this is exceptional.

Two elevators are normally adequate to serve apartment units of over six stories. Even when the traffic does not appear to warrant them, two elevators are needed so one will be available when the other is being serviced. Usually, both elevators are located in a single bank near the building entrance, one being used for freight and service work during part of the day and for passenger carrying during the

periods of increased traffic discussed above. Sometimes the second elevator is strictly a service and standby elevator and is located near the service entrance. Six stories is the maximum which healthy tenants can be expected to climb without hardship, even in emergencies, hence the emphasis on two elevators for over six floors.

There are two important exceptions to this two-elevator rule. First, in high rental buildings it is sometimes desirable to provide two passenger elevators and a third elevator for freight and service. Second, the "apartment hotel" type of building characterized by many small apartments and single room suites needs elevator service similar to that of a hotel, and may require more than two passenger elevators. These cases must be given special study when they occur.

What Floors Should the Elevators Serve?

The elevators in an apartment house should serve all the floors on which there are apartments. They should also serve the basement, if the building has a basement, and particularly if the basement is used for laundry and tenant services. In apartment buildings where the roof is used for sun bathing or recreation one elevator may serve the roof, but this extension of service to the roof is rarely encountered except in very large metropolitan installations. Normally, each passenger elevator in an apartment building has hoistway entrances on and serves every floor from the basement to the top floor.

There is an arrangement known as "skip-stop" in which elevators serve alternate floors. This arrangement was proposed as a means for providing the minimum functional requirements of high-density buildings at the lowest possible cost, and has been specified for a few low rental housing projects. It reduces the initial cost of the elevator installations, principally by eliminating alternate hoistway entrances, but does not provide tenants with good elevator service.

What Type of Control Should the Elevators Have?

There are two basic types of control used with modern passenger elevators—signal and collective. As far as their applicability to apartment building elevators is concerned, the fundamental difference between the two is that signal control elevators require an attendant, while collective control elevators can be operated by either the passenger or an attendant.

The present trend, insofar as apartment house installations are concerned, is toward the collective control elevator for even the highest class of buildings. This type of operation provides a reliability which is independent of the availability of labor and which lacks nothing in prestige or security. Elevator attendants and doormen can be used with these elevators when desired, yet they can be dispensed with when not available. Many apartment houses have found that unattended collective control elevators plus a doorman provide better elevator service and greater security at much less cost than attended elevators without a doorman.

A collective control elevator is fully automatic and doesn't require any attendants yet it responds to car and landing calls in the order in which the landings are reached, rather than in the order in which the buttons are pressed. It also differentiates between UP and DOWN calls, answering only UP calls when traveling upwards and DOWN calls when traveling downwards.

When two collective control elevators operate as a bank to serve a single building unit, their operation is usually coordinated so that calls registered from landing buttons are answered by only one car—the one which is in a position to arrive at the

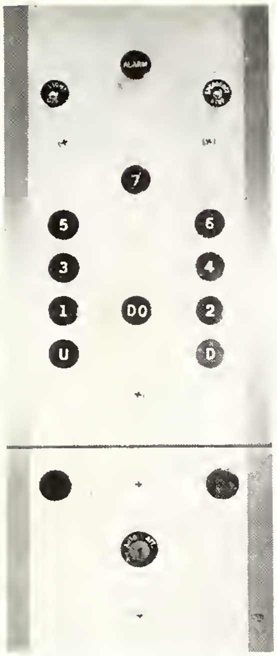


Fig. 3. A car control panel of the type installed in Collective Control Elevators which are operated by an attendant all or part of the time. The provision for attendan toperation consists of an auxiliary panel with a key switch marked "attendant" and "automatic."

Fig. 4. A car control panel of the type installed in Collective Control elevators which are passenger operated at all times.

landing first, traveling in the appropriate direction. This type of operation is often referred to as "Duplex" collective.

Each car answers all calls made on its own operating panel and either car can be detached from the system and operated individually as a service elevator if desired. Sometimes a separate riser of "service" landing buttons is provided if one car is to be used regularly as a service car.

Another type of automatic elevator control formerly very popular and still used occasionally is the "single automatic push button" type. With this control, the elevator answers only one call at a time and when answering a call it will neither respond to nor "store up" other calls. This type of control is no longer considered modern and is not recommended for new construction where the owner will expect his building to be reasonably up-to-date 20 years from now.

Signal control elevators are occasionally used in tall, high rental apartment buildings in large cities. For office buildings, or wherever heavy traffic is to be handled, signal control elevators provide a quality of service which the collective control elevator cannot duplicate. However, collective control elevators have been found adequate for even the most exacting apartment house service, and before choosing signal control elevators for any apartment building, the owner and architect should be sure that they will have no use for the automatic self-service features of a collective control installation. When used in an apartment house, signal control elevators should always be equipped with the "night service" feature which permits untrained persons to operate the elevator in emergencies.

Attendant Operation Provisions

Collective control elevators may be obtained with or without the attendant operation feature but attendants should be provided for if there is a reasonable probability of their being needed. Typical car control panels for elevators with and without the "attendant" provision are shown in Figs. 3 and 4. It will be noted that the provision for attendant operation consists of an auxiliary panel containing

a key switch marked "attendant" and "automatic." When the elevator is to be passenger operated, the switch is locked in the "automatic" position and the elevator functions as an automatic full collective control elevator. When an attendant is in the car, however, he turns the switch to the "attendant" position which gives him complete control of the closing of the car doors and the starting of the car.

Speed

The optimum speed for an apartment house elevator depends primarily upon the height of the building. In low rise installation up to six stories the speed of the elevator has little effect upon the average "interval" which passengers must wait for the elevator because loading, starting, and stopping require more time than traveling. Elevator speeds of about 200 feet per minute are commonly recommended for such installations.

For high rise installations, the reverse is true and higher elevator speeds materially reduce the waiting interval. For buildings of ten or more stories, speeds of 400 feet per minute or more are recommended. For buildings of six to ten stories, the optimum speed is not well defined, but usually lies around 300 or 350 feet per minute.

The public is somewhat less critical of the waiting time in apartment houses than in office buildings. For example, a sixty second interval in a busy office building would not be tolerated, whereas an interval of a minute may not be excessive in an apartment building. Nevertheless, an excessive interval—particularly an irregular interval to which attendants contribute by inattention—will be a source of annoyance and complaints and should be avoided.

Load and Platform Size

In order to minimize the danger of overloading passenger elevator cars, their platform area is limited by the load which they are designed to carry, as specified in the American Safety Code for Elevators. A given area may be obtained by an infinite combination of dimensions but the major elevator manufacturers, working through the National Elevator Manufacturers Industry, have standardized upon a limited number. It is from these standard sets of dimensions that all passenger platforms should be chosen.

Of the several platform sizes which are considered standard for passenger elevators, only four find extensive application in apartment buildings. These four sizes are all relatively small since high passenger handling capacity, even during periods of increased traffic, is not a factor in apartment elevators. The recommended platform dimensions, together with their respective passenger capacities, are as follows:

TABLE 1

Rated Load	Passenger Capacity	Platform Size	
		Width	Depth
1200 lbs.	8	5'0	4'0
2000 lbs.	13	6'4	4'5
*2000 lbs.	13	6'4	4'8
2500 lbs.	16	7'0	5'0

* For 400 f.p.m. speed and over.

The 1200 lb. capacity platform is large enough to handle the passenger traffic in most installations, but is too small to accommodate furniture. It is frequently used in small three and four story apartment houses, but is not recommended for larger installations. The 2000 lb. capacity platforms will satisfactorily accommodate furniture and are therefore widely used in apartment houses of all sizes. The 2500 lb. platform is used where "extra" service and spaciousness are factors.

Service Elevators

The preceding discussion of control, speed, and size is based principally on passenger handling requirements. It applies equally well, however, to apartment building elevators which are to be used for *both* passenger and service purposes, as in buildings with a single elevator, and those with a bank of two passenger elevators of which one will be used for service purposes part of the time. Removable wall pads are recommended for protecting the finish of the car when these elevators are being used for handling furniture or bulky freight.

When a separate service elevator is provided, it should be located near the building's delivery entrance, and should have a 2500 lb. platform, or larger, to accommodate bulky furniture. Its control should be a type which does not require full time attendant operation—collective control with the attendant feature being generally employed in modern installations. Speeds from 150 to 350 feet per minute are commonly specified for service elevators.

Hoistway Size

The hoistway size is governed by the size of the platform and the clearances required on each of its four sides. These clearances are necessary to provide room for such items as car guide rails, counterweights, counterweight guide rails, hoistway wiring, hoistway doors, switches, interlocks, etc. The following table shows the hoistway sizes required for several sizes and speeds of elevators commonly used in apartment buildings. Due to the standardization program referred to above, the values shown are approximately applicable to many makes of elevators but in practice the only safe procedure is to obtain data and dimensions direct from the manufacturer of the equipment to be installed.

TABLE 2

Rated Load	Platform Size		Hoistway Size	
	Width	Depth	Width	Depth
1200 lbs.	5'0	4'0	6'4	5'3
2000 lbs.	6'4	4'5	7'8	5'9
*2000 lbs.	6'4	4'8	7'8	6'0
2500 lbs.	7'0	5'0	8'4	6'4

* For 400 f.p.m. speed and over.

Pit Depth

The depth of the pit, or distance from the lowermost landing to the bottom of the hoistway, is governed by the speed of the elevator and the local building code. Sufficient depth must be provided to allow for over-run of the car, for installation of a buffer, and for the other necessary pit equipment. Allowances generally range from approximately 4½ feet when the speed is 100 f.p.m. or less to 12½ feet for 600 f.p.m.

Overhead Clearance

The overhead clearance, or distance from the uppermost landing to the top of the machine room supports, is another dimension which is dependent upon the speed

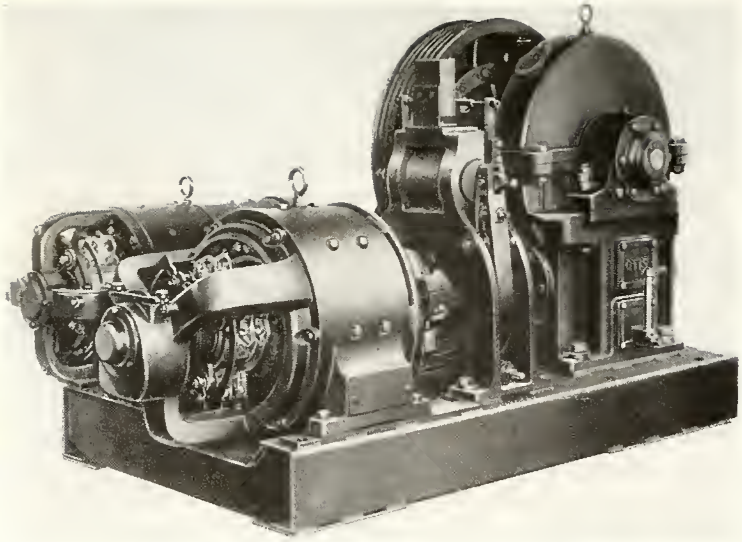


Fig. 5. A geared (direct current) elevator hoisting machine of the type used for low-speed apartment building installations. Note the housings of the worm and gear employed between the driving motor and hoisting sheave.

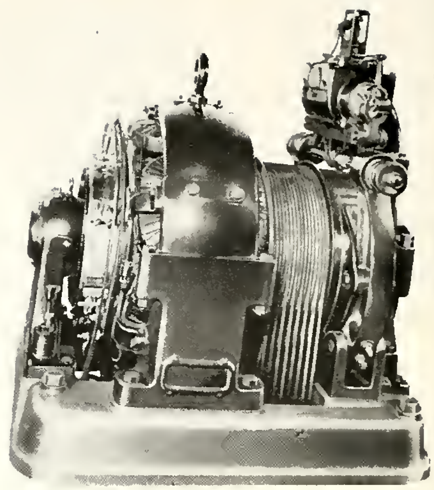


Fig. 6. A gearless (direct current) elevator hoisting machine of the type used for medium and high-speed apartment building installations. The driving sheave of this machine is mounted directly on the shaft of the motor.

of the elevator and local code requirements. This clearance must provide for the height of the carframe, a runby allowance, and whatever overhead machinery projects below the machine beams. It will vary from about 15½ feet for an 100 f.p.m. elevator to about 25 feet for one with a speed of 600 f.p.m.

Due to the influence which the type of equipment and local code requirements will have on pit and overhead dimensions, it is not always possible to fix these dimensions in the preliminary planning stage; architects should remember that pit and overhead allowances may have to be changed when the equipment is finally decided upon.

Should the Machine Be Above or Below?

Wherever possible, the machine and its control equipment should be mounted above, directly over the hoistway. When the machine is mounted below, the overhead loading is materially increased, the number of auxiliary sheaves is increased, and the length of the hoisting ropes is nearly doubled. All of these disadvantages involve increased maintenance costs, as well as increased installation costs, so that any saving in penthouse construction is more than offset. Formerly, it was considered that mounting the machine below eliminated noise in top-floor apartments, but with the advent of sound isolation for machines and quiet switches for controllers, this argument is no longer valid.

Type of Machine

There are two types of elevator hoisting machines commonly used with electric passenger elevators: geared machines and gearless machines (Figs. 5 and 6).

Geared machines employ a worm and gear between the driving motor and the hoisting sheave. This gearing reduces the speed of the sheave and increases the lifting power of the motor, making possible the use of driving motors which rotate at speeds of from 600 to 1800 RPM. Gearless machines have the driving sheave

mounted directly on the shaft of the motor and no gears are employed, so the motor must necessarily be designed to operate efficiently and deliver high torques at low speeds.

Where they can be used, gearless machines are generally considered superior to geared machines, as between a gearless and a geared machine, equally well designed and constructed and operating under identical conditions, the gearless machine will consume less power for the same number of trips and stops, will operate more smoothly over a longer period of time, will stay in adjustment better and be quieter, will require less replacement of parts, and will have a longer over-all life than the geared machine. This is because the worm and gear of the geared machine involve areas of friction and wear which are not present with the gearless machine. On the other hand, the initial installation cost for a gearless machine will probably exceed the initial cost for a geared machine.

From the above, it appears that gearless machines should be superior to geared machines for all installations. From a practical standpoint, however, this is not the case. As the rated speed of a direct current motor goes down, the size and weight of the motor goes up because more iron is required to conduct the increased magnetic fields of slow speed motors. In effect, this means that the practical application of gearless machines is limited to medium and high speed elevators and that geared machines must be used for low speed elevators.

Just what the critical speed is, above which gearless machines are preferable and below which geared machines should be used, is a highly controversial subject. Gearless machines are seldom used for elevator speeds below 300 f.p.m. and most elevator manufacturers provide gearless machines for all speeds above 400 f.p.m. Between these limits, however, the relative merits of the several sizes of geared and gearless machines offered by the various manufacturers are not clearly defined.

In most cases, the choice between a geared and gearless machine will be made by the manufacturer on the basis of the height of the building, the duty of the elevator, and the class of elevator service to be furnished. For apartment buildings ten stories or less in height, geared machines are generally considered adequate. For higher apartment buildings, gearless machines are usually recommended.

Alternating vs. Direct Current Motors

All gearless elevator machines have direct current motors. Likewise, most geared machines designed for use with elevator speeds of over 100 feet per minute are equipped with direct current motors. The reason direct current motors are preferred to alternating current motors is that the former have better starting and stopping characteristics and their speed is more easily controlled over wide ranges.

Direct current for the driving motors of elevators is usually supplied by motor generator sets, a separate set being used for each elevator. This permits application of one or another of the various extensions of the Ward Leonard system of speed regulation for direct current motors. These extensions differ in detail, but they adhere to the same basic principle which depends upon magnetic reluctance and hysteresis to smooth out the voltage characteristics of the generator and the speed characteristics of the elevator driving motor. The armatures of the generator and elevator driving motor are connected in series and the speed and direction of the driving motor are regulated by varying the field and hence the terminal voltage of the generator.

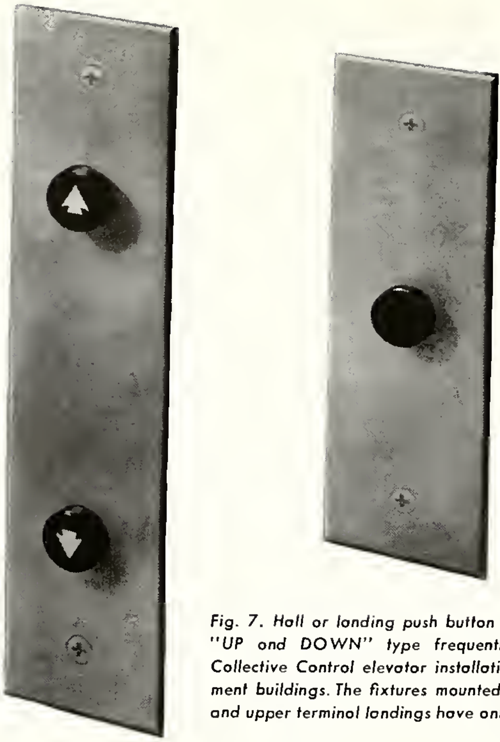


Fig. 7. Hall or landing push button fixture of the "UP and DOWN" type frequently used with Collective Control elevator installations in apartment buildings. The fixtures mounted at the lower and upper terminal landings have only one button.

Fig. 8. A hall position indicator of the type sometimes installed at the lobby entrance of apartment building elevators. This fixture shows waiting passengers the location of the elevator in the hoistway.

From a service standpoint, the advantages of a direct current driving motor, properly controlled, are measurable in terms of smoother riding cars, lower starting current, dynamic braking, and a generally higher quality of operation. Thus, wherever alternating current and direct current machines are both available for the same elevator speed, the choice, as is usually the case whenever a choice of equipment is available, must be made between quality and first cost.

This overlapping of speed and consequent choice of machines lies between speeds of about 100 and 250 feet per minute. For elevators whose rated speed is 100 feet per minute or less, and where traffic is expected to be very light, there are fewer opportunities for the higher quality of direct current installations to demonstrate themselves, and alternating current motors are generally used. These motors function very satisfactorily on low rise low speed installations where the extra cost of direct current could not be justified.

Machine Room Dimensions

The minimum "inside" dimensions of the machine room required for apartment building elevators varies from about 7½′ × 11′ for a single low speed elevator to approximately 17′ × 22′ for two "Duplex" high speed elevators. If the most efficient utilization of space is important, it is advisable to obtain exact dimensions from the manufacturer before completing the design of the machine room.

Leveling

Apartment house elevators should be equipped with the "self-leveling" feature. All automatic elevators will stop within a short distance of the landing due to the action of the automatic stopping equipment but unless the self-leveling feature is provided they will not automatically level themselves. This means that, due to variations in car loading and other factors, the platform of a non-leveling elevator may be several inches above or below the landing when the car comes to rest.

Many automatic elevators without the self-leveling feature have been installed in

Fig. 9. Hall or landing push button fixtures of the Dial type. These, in addition to serving as push button units, also serve as hall position indicators and show waiting passengers the location of the car in the hoistway.

apartment buildings in the past but they cannot be considered modern or desirable. The importance of having the platform level with the landing in apartment houses, where the passengers are often laden with babies and bundles, is obvious when one considers that tripping accounts for an appreciable number of all the accidents which occur at elevator entrances.

Hall Fixtures

The hall fixtures used in apartment buildings with collective control elevators usually consist of UP and DOWN push buttons (Fig. 7) at each floor (except at the topmost and lowest floors where only one button is provided) and a hall position indicator mounted over the door at the main lobby landing (Fig. 8). The position indicator is usually omitted in low rise installations and wherever economy of first cost is paramount.

An improvement over the plain push button fixture which is sometimes used consists of a small dial indicator mounted in the push button face plate (Fig. 9). This device indicates the position of the car in the hoistway and its motion shows prospective passengers that the elevator is moving. Passengers will wait for the car with considerably less impatience and for appreciably longer intervals if they can see some indication of action, whereas they become restless very quickly if they press a button and nothing happens. For this reason, the dials are sometimes recommended in low cost installations where the interval is long but it is not practical to install an additional elevator.

In higher class installations, hall position indicators are sometimes used over each hoistway door at each landing.

Door Openings

There is an optimum width of door opening for each of the platform sizes recommended for apartment house use. Chosen from a passenger handling standpoint, they have been found the most efficient for use with their corresponding platform

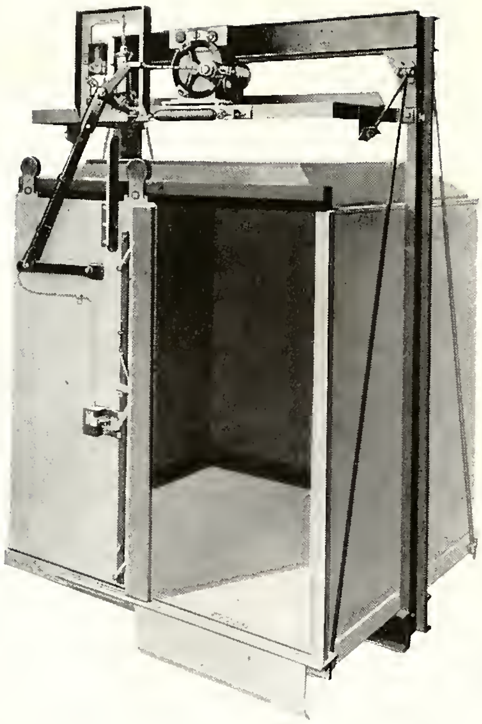


Fig. 10. One type of moderate speed door operator. This device opens and closes the car and the hoistway doors when the car is at a landing. With modification it is employed with center opening and two speed slide doors as well as with the single slide type shown. Note the safety shoe mounted on the front edge of the car door.

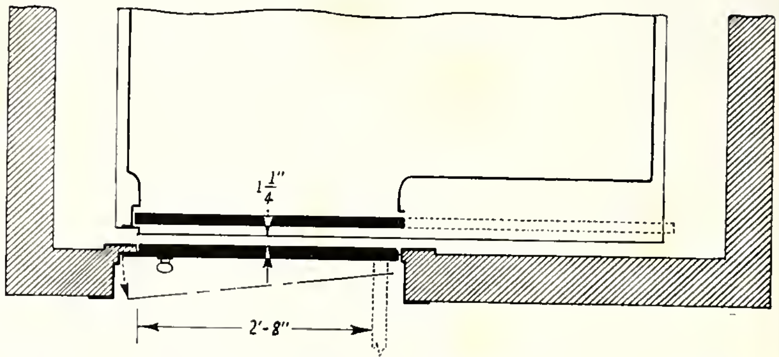


Fig. 11. A layout showing the door arrangement commonly used with the 1200 lb. capacity elevator cars in small buildings. The car has a single slide door, power operated, and the hoistway entrances are equipped with manually operated single swing doors.

widths and thus standardized upon. They are as follows:

TABLE 3

Duty Load	Platform Size	Door Opening
1200 lbs.	5'0 × 4'0	2'8
2000 lbs.	6'4 × 4'5 or 4'8	3'0
2500 lbs.	7'0 × 5'0	3'6

Car and Hoistway Door Operation

Both the car and hoistway doors should be power operated in all installations which employ the 2000 lbs. capacity car with 3'0" clear door opening or the 2500 lbs. capacity car with the 3'6" clear door opening. With collective control elevators, a moderate speed operator (Fig. 10) is used which opens the car and hoistway doors simultaneously. When the elevators are on "automatic" operation the doors open as a landing is reached and remain open for a predetermined interval (about 5 seconds) before closing. When the elevators are being operated by an attendant, the doors open as the landing is reached, and remain open until caused to close by the attendant. For signal control elevators, a high speed door operator is usually recommended.

Whenever a moderate speed electric door operator is used on an automatic elevator, the car door should be equipped with a safety shoe. This consists of a flexible rubber section mounted on the front edge of the door. If it touches a passenger or obstruction, the projecting shoe yields and makes an electric contact which causes both car and hoistway doors to reverse to the open position. High speed door operators are not recommended for automatic elevators.

For small buildings with low rise elevators, where the 1200 lbs. capacity car is used,

Fig. 12. One type of slow speed door operator. Slow speed operators are used to open and close the car door in arrangements similar to that illustrated by Fig. 11. Safety shoes are not required as the action of the power operator is delayed until the hoistway door is closed by hand, and passengers are clear of the entrance.

the hoistway door may be manually operated. Figure 11 shows the details of this arrangement. The car has a single slide door, closed and opened by a slow-speed electric operator, and the hoistway has a single-swing door at each of its entrances. The car door opens when the car arrives at a floor, and the hoistway swing door at that floor can then be manually opened from either side. Before the car leaves a landing, the hoistway door closes itself by spring action, and the car door closes by power after the hoistway door is closed. One type of slow speed door operator is illustrated in Fig. 12.

Door Types

In addition to the single swing door referred to above, there are three types of horizontal sliding car and hoistway doors used in apartment buildings: single slide, two-speed slide, and center-opening.

The single slide type of operation is satisfactory for door openings up to and including 3′0″ and is widely used with the 2000 lbs. capacity "all purpose" apartment building elevator. Figure 13 is a plan view of this type door installation.

With the 2500 lbs. capacity car (3′6″ door opening) either center opening or two-speed car and hoistway doors can be employed. A door plan for the former is shown in Fig. 14; Fig. 15 illustrates the latter. Center-opening doors require more space, but they are usually recommended wherever they can be employed. The two-speed arrangement, in which one section of the door travels twice the distance at twice the speed, is used where space limitations prohibit center opening doors.

Door Safety Devices

All elevator entrances in apartment buildings must be equipped with adequate safety devices. Electrical-mechanical interlocks to prevent hoistway doors from being opened when the car is not at the landing are required by all building codes and should never be omitted. These interlocks must also prevent movement of the

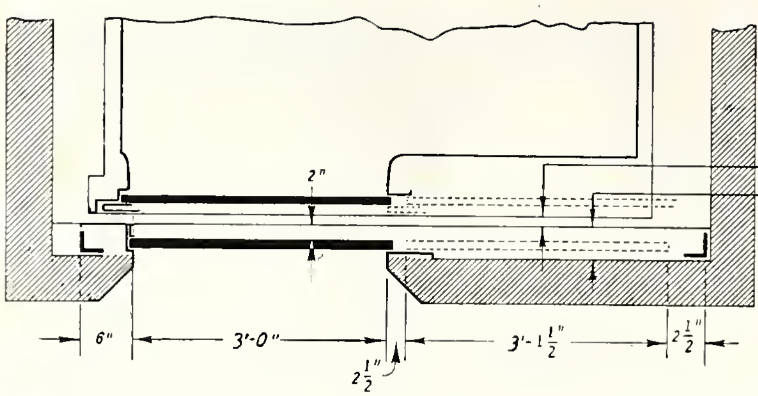


Fig. 13. A layout illustrating single slide car and hoistway doors. This arrangement is widely used for clear door openings up to 3'-0".

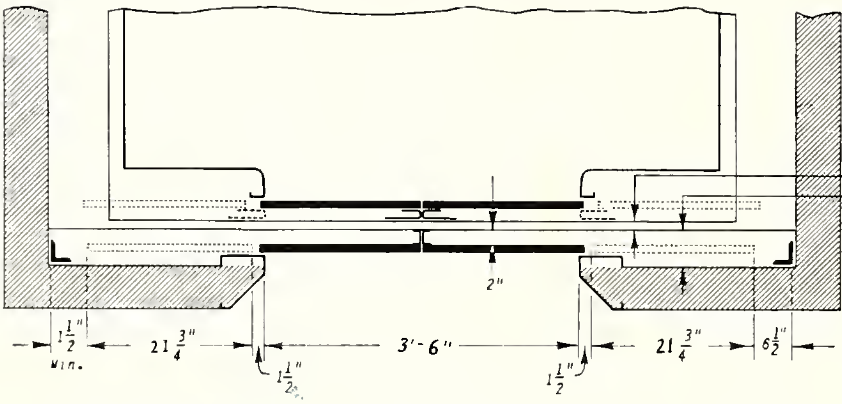


Fig. 14. A layout illustrating center opening car and hoistway doors. This door arrangement requires more space for installation than other types, but provides superior service. It is usually applied to clear door openings of greater than 3'-0"

car while the hoistway doors are open. Car doors should be equipped with electric contacts which prevent the car from moving unless the car door is fully closed.

Because an overwhelming proportion of all serious elevator accidents involving the riding public occur at hoistway entrances, the importance of adequate door safety devices cannot be overemphasized.

Layouts

When negotiations for the purchase of apartment building elevators reach the stage where the number and type of elevators have been decided upon, the manufacturer chosen to install the equipment prepares a "layout" showing the proposed installation in both plan and elevation. It is based upon the building plans, and provides all of the information required by the architect and the building contractor.

For the architect's preliminary studies, such detailed layouts are not generally available. However, most manufacturers are prepared to furnish on request preliminary "typical layouts" for any standard type of elevator installation. Such a typical layout will provide sufficient hoistway dimensions and other information so that preliminary plans can be drawn, but all "typical" layouts must be used with caution, as local codes and other considerations may alter the standard dimensions shown.

Figure 16 shows a typical layout for one manufacturer's "Duplex" arrangement of two elevators with duties of 2000 lbs. at 400 feet per minute.

Reactions on Supports

As stated in the introduction to this chapter, the architect can obtain the complete solution to his vertical transportation design problems by consulting a reputable and competent elevator manufacturer. The solution, as worked out after due consultation with the architect, will be presented in the form of the final layout, and

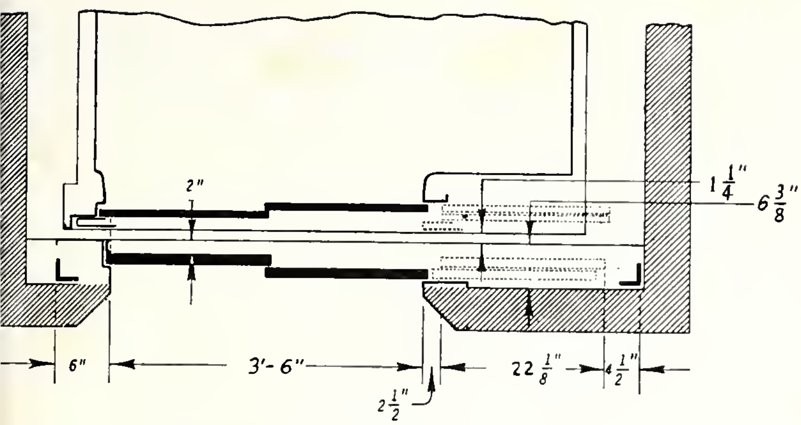
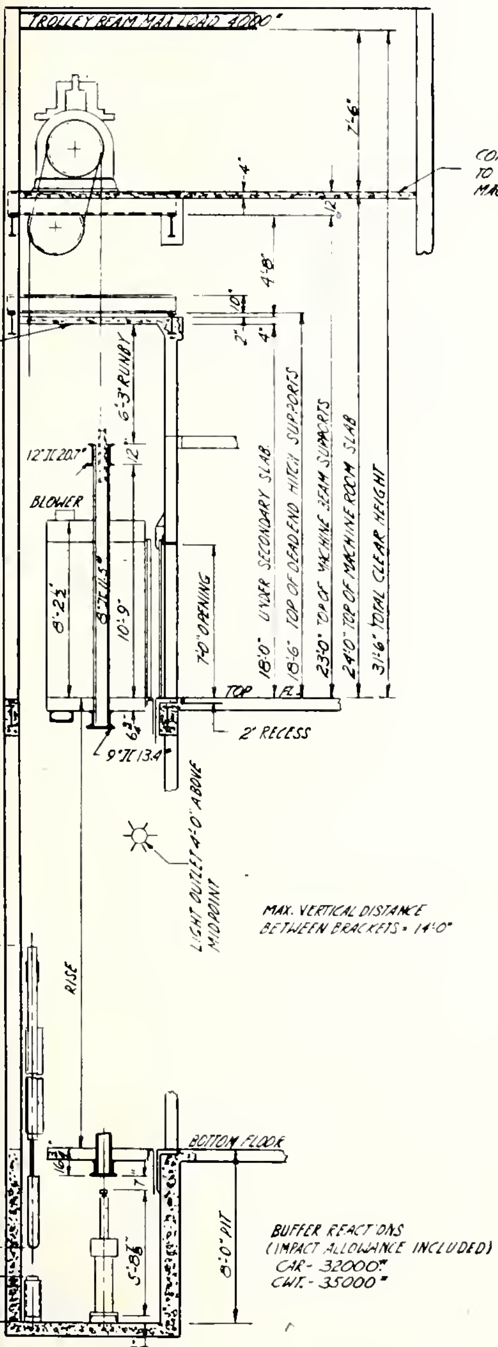


Fig. 15. A layout illustrating two-speed car and hoistway doors. In this arrangement one section of each door travels twice the distance at twice the speed.



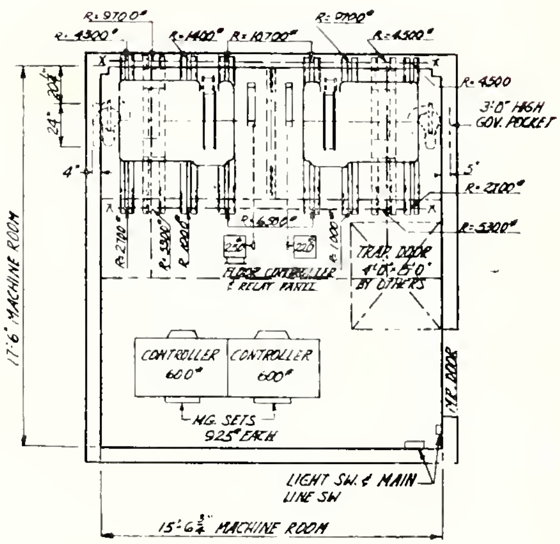
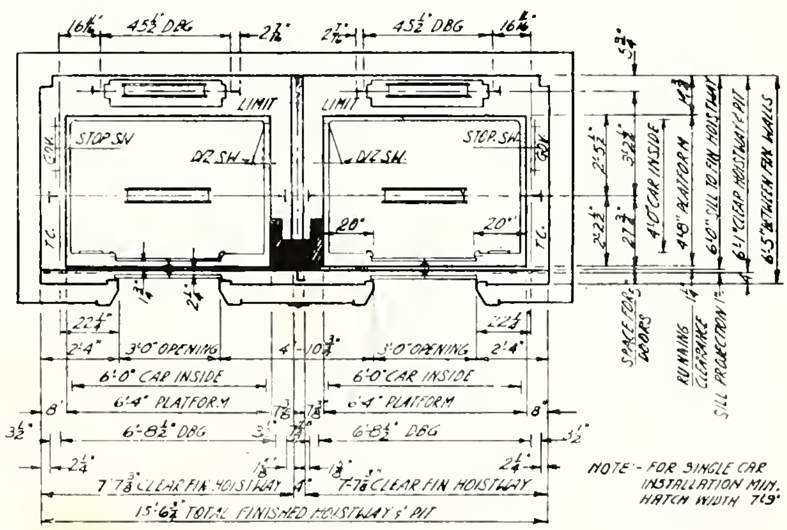


Fig. 16. A typical layout for one manufacturer's "Duplex" arrangement of two elevators. The cars are of the 2000 lb. capacity size designed to operate at a speed of 400 f.p.m.



amplified by a specification in a contract. However, there is one responsibility in connection with the installation of elevators which the manufacturer will not assume. The architect, engineer, or builder must be responsible for the design of the building structure to withstand the stresses which the elevator will induce in it.

In designing a building to receive an elevator, proper support must be provided for the elevator and its machinery. Walls, or beams capable of supporting the weight of the machine, the loaded car and the counterweight, plus an allowance for impact loading, must be provided at the top of the hoistway. Also, firm supports for the brackets which support the guide rails must be provided at each floor. Table 4 indicates the approximate order of magnitude of the overhead loading for some typical apartment house elevators. The specific reactions to be provided for and their points of occurrence are always computed for each individual installation and furnished to the architect by the elevator manufacturer, based upon the equipment selected.

TABLE 4

Rated Load (Pounds)	Rated Speed (F.p.m.)	Sum of Approx. Reactions on Machine Beam Supports	
		Counterweight Side of Hoistway	Entrance Side of Hoistway
1200	100	8500 lbs.	7000 lbs.
2000	100	15000 lbs.	10000 lbs.
2000	200	16500 lbs.	12000 lbs.
2000	250 to 350	17500 lbs.	13000 lbs.
2500	200	18000 lbs.	17000 lbs.
2500	250 to 350	20000 lbs.	18000 lbs.

CHAPTER 3: Landscaping

BY ALFRED GEIFFERT, Fellow, A.S.L.A.

The development of the landscape, of which the apartment house is a part, has in its planning certain fundamental considerations that are common to any successful treatment of the earth's surface for human use and enjoyment.

These fundamental considerations relate to:

1. The site as part of its surroundings
2. Topography of the site and existing natural features
3. Approaches
4. Area allocations
    a. Buildings
    b. Surface utilities
    c. Recreation
5. Orientation
6. Three dimensional considerations
    a. Composition
    b. Views
    c. Lighting
7. Materials—color—texture—scale
    a. Structural
    b. Planting

The problem of designing the landscape features in connection with apartment houses provides an interesting opportunity in the field of site planning. Generally speaking it is an obligation to create a comprehensive plan which will provide all or practically all of the facilities required for a diversified use for all ages.

The Site as Part of Its Surroundings

As the apartment house owes its existence to intensive use of a small land area by many individuals, so it becomes a unit within a community, and so it is affected by and affects its surroundings.

One might consider building a wall around a given area, this, however, does not make it less a part of its surroundings, for man does not by nature isolate himself from his fellowman, he moves in and out as the need of intercommunication dictates his use of time, and because of this every small community becomes a part of a larger community. Man's basic needs are identical with those of his neighbors, though his individual expression in fulfilling these requirements may differ greatly.

In designing an apartment house development the single apartment—a unit which the individual family considers and makes its home—becomes the modual for duplication to serve many families under one roof. This module or core is a place around which family life centers, and is a home among many homes making up an apartment house. As individual homes these units are part of a community where the ambitions and hopes of many families are reflected and affected by environment.

It is presumptious to assume that all members of society will aspire to greater heights because of an environment, no matter how much it may offer in physical and esthetic quality. On the other hand it is safe to say that such an environment does give the opportunity, and thereby affects the individual family as well as the community, and offers opportunity to elevate the spirit and desire for fuller living.

As the architect is responsible for the physical comforts of many family units comprising the apartment house or houses within a development, so the landscape architect is concerned with the design of the surrounding areas encompassing the site.

Topography and Existing Natural Features

As the study and development of a site plan is governed by the topography and existing natural features of the area involved, the choice of a fitting site, possible of economic development, become of first importance.

Flat land, gentle rolling land, steep and hilly land, each has distinct merit for consideration in the economic and esthetic study of values. Taken separately, flat land although more readily adaptable to economic construction of an apartment house development offers less in esthetic opportunity. Flatness is conducive to monotony, limits the scope of design, and, therefore, challenges the ability of the designer to make it interesting.

It is monotonous to see a group of buildings with identical long flat, horizontal roof lines paralleled by accompanying sill lines. This monotony may be remedied by staggering and placing buildings at angles to one another to do away with the parallel and perpendicular planes, and further by breaking up the dull planes by groupings of trees and shrubs we can achieve a sense of informality and openness, relaxing in contrast with the much too usual stiff, tight, tense feeling prevalent in many of our present day apartment house communities (Figs. 1, 4). Rolling land makes possible a more flexible design and through movement of contour a more interesting composition. This is reflected in the varying levels of floors, sill and roof heights of the buildings making up the development. Each building gains in individual importance because it will differ in approach, elevation, and setting as related to its neighbor.

Steep and hilly land offers most in making possible a development of picturesque interest, it entails however greater expense in its development. This greater cost is justifiable for it will draw a discerning tenant who finds pleasure amid surroundings made individual by the use of terraces, ramps and walls, and the planting treatment dictated by them, a higher rental may well be forthcoming.

Fig. 1. Vladeck Houses in New York City. Shreve, Lamb and Harmon; W. F. Ballard, Sylvan Bien, architects: Gilmore D. Clark, Michael Rapuano, landscape architects. Sketches by Chester B. Price.

To the designer a development on this kind of topography is most fascinating and satisfying, even though confronted with greater construction problems his efforts will be rewarded with a development of variety and sparkle.

Under existing natural features we consider trees, shrubs, water, rock, rocky ledges, and the like as assets to our resources for development. Preservation and use of them in our composition is our first concern for these are elements of value and charm well nigh impossible or impracticable to duplicate. These natural features, few or many, place a stamp of stability on any site, and give a character that age alone can supply —this offsets man's constant though conscientious effort to simulate nature.

Approaches

Man moves on foot, in his car, or by public conveyances. These then, are the factors to be considered in the approaches to and from his dwelling—foot paths, roads, parking areas, bus stops and, at times, trolley lines.

Let us consider first man on foot necessitating a system of paths to afford fluid circulation within the project (Figs. 1, 3, 5). The shortest distance between two points is a straight line and given no paths we would find in a short time that the entire project would have a pattern of straight line earth trails from house to house, to bus stop, to market, to theater, etc. In arriving at our ultimate hard surfaced path pattern all these routes must be considered and evaluated. Those who work must be given as direct a route as possible to and from any point in the project to any available public conveyance they might use. The housewife must be given a route to her nearby market and shopping center. The family who owns a car must be able to get to their garage or parking area, and lastly each and every family must be able to get from their individual apartment to any or all points within or outside the project on which their attentions are focused.

Fig. 2. Marcy Houses, Brooklyn, N. Y. Voorhees, Walker, Foley and Smith; F. P. Platt and Bro., Adolph Goldberg, associated architects; Alfred Geiffert, Jr., landscape architect.

A great many of these paths will serve one or more purposes. For example, a direct path to a nearby shopping center may also be used as access to a garage, parking area, or bus stop. These more important paths, because of multiple uses, should be wider and of more durable material than those of lesser importance.

In planning the road system (man riding on wheels) the exterior road approaches will in large measure dictate the motor movements to, within and through the project. Our concern here deals with easy access, safety and parking facilities. Within a planned city definite routes have been established, with restrictions ordered by law, and public utilities in place. This places limits on planning that cannot be ignored. Through traffic is always a hazard to safety and when it cannot be eliminated makes careful planning to direct human movement most essential.

If our project is in an outlying area or less developed area where there are fewer restricting factors we are able to develop our site and road net integrally. We must then, however, also plan our bus line stops, where applicable, parking areas, and accesses to and from various neighboring facilities to be used by, or to service the project.

Area Allocations

In the event that our project is to be designed as more or less self sufficient we must plan locations, with regards to accessibility to stores, garages, theaters and the like. A development of this sort is a challenge to the site planner as it involves so many elements so varied in their scope yet so closely allied. Is it possible or advisable to permit parallel parking throughout the area? Would it be better, more functional, to outlaw this practice and provide one or more large garages or parking areas within the project to handle the involved cars? Is there an area topographically suited, situated far enough away from the dwellings, so the noise of traffic is not annoying to the tenants? How many such areas are there and how large must each be?

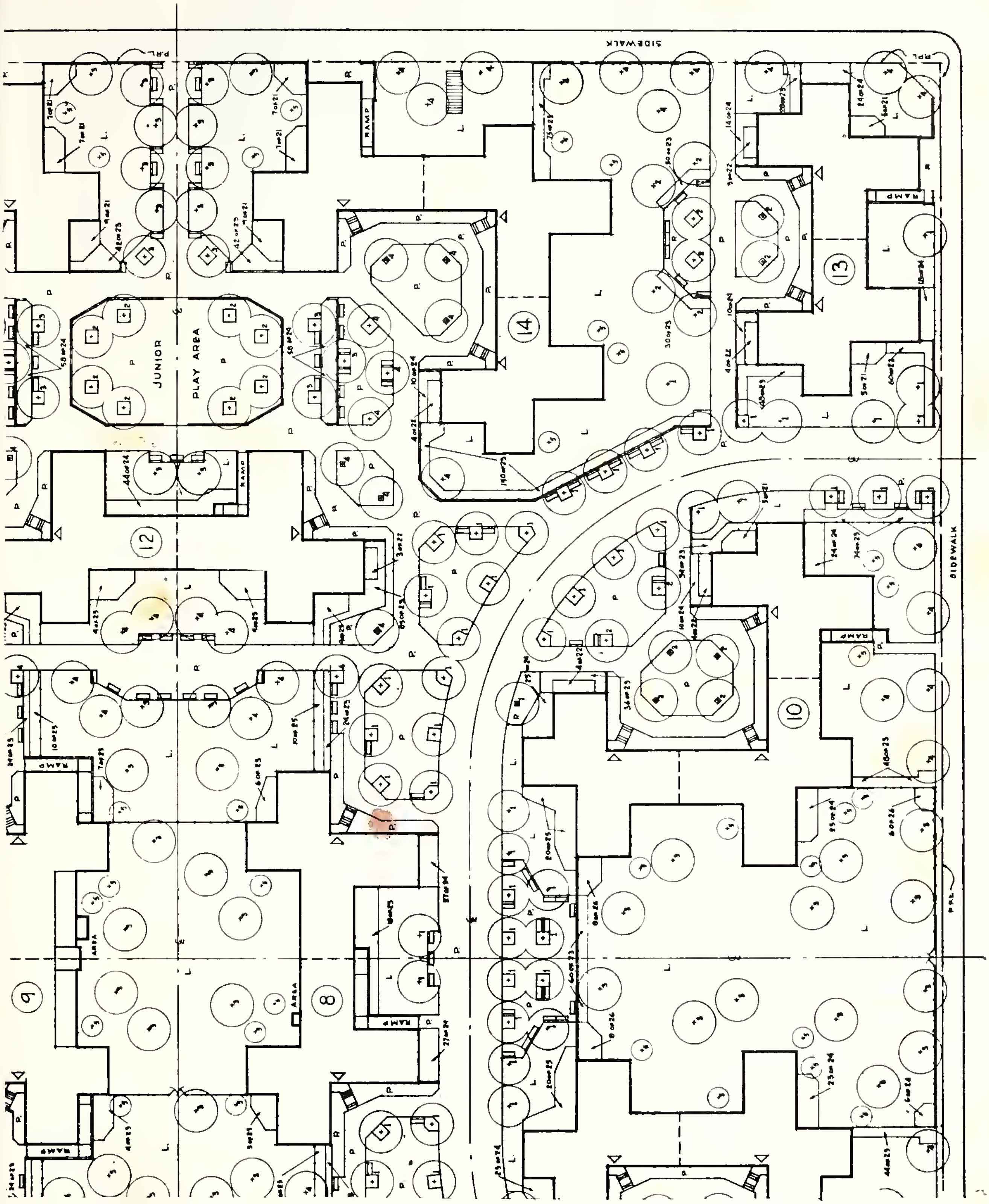


Fig. 3. Plot plan of Marcy Houses, Brooklyn, N. Y.

Fig. 4. Brownsville Houses Brooklyn, N. Y. Frederick G Frost, John A. Thompson associated architects; Fred N Severud, structural engineer Alfred Geiffert, Jr., landscap architect. Sketch by Cheste B. Price.

Wouldn't such a large paved area present many complex maintenance problems? How about snow in the winter, the hot mid-summer sun reflecting off the pavement? Is it possible to plan these areas so as to shade them with trees, to screen them with shrubs, to adequately drain them, and to locate them so they are easily accessible?

The answer to most of these questions will be governed by the topography of the site, the policy of those sponsoring the project, the class of people to occupy it, and the inevitable expense involved.

The matter of bus, trolley, or railroad lines must be thoroughly investigated, studied, and planned with those concerned, to arrive at an adequate servicing of the project. The location will in a large sense solve this problem. If the volume of traffic is sufficient most any of the utilities involved will conform with schedules and stops required. It then becomes only a problem of estimating the needs and providing for them, again with an eye to tying in bus or trolley stops with the aforementioned fluid circulation and accessibility.

In an apartment house community the total area is allocated to areas covered by buildings, surface utilities, and recreational facilities. It is with difficulty that we adhere to statistics, even minimum requirements, as a guide covering densities, percentages of area to be used for recreation and the like, as each new development differs as regards location, class of people occupying it, and policy of organization and sponsorship. Obviously, after the building area is determined, a minimum of surface utilities such as roads, parking areas, paths, retaining walls, and surface drainage mean economy in construction and an increased area available for recreation. The area coverage of buildings having been established by the architect, leaves the remaining area of the site to be planned for surface utilities and recreation.

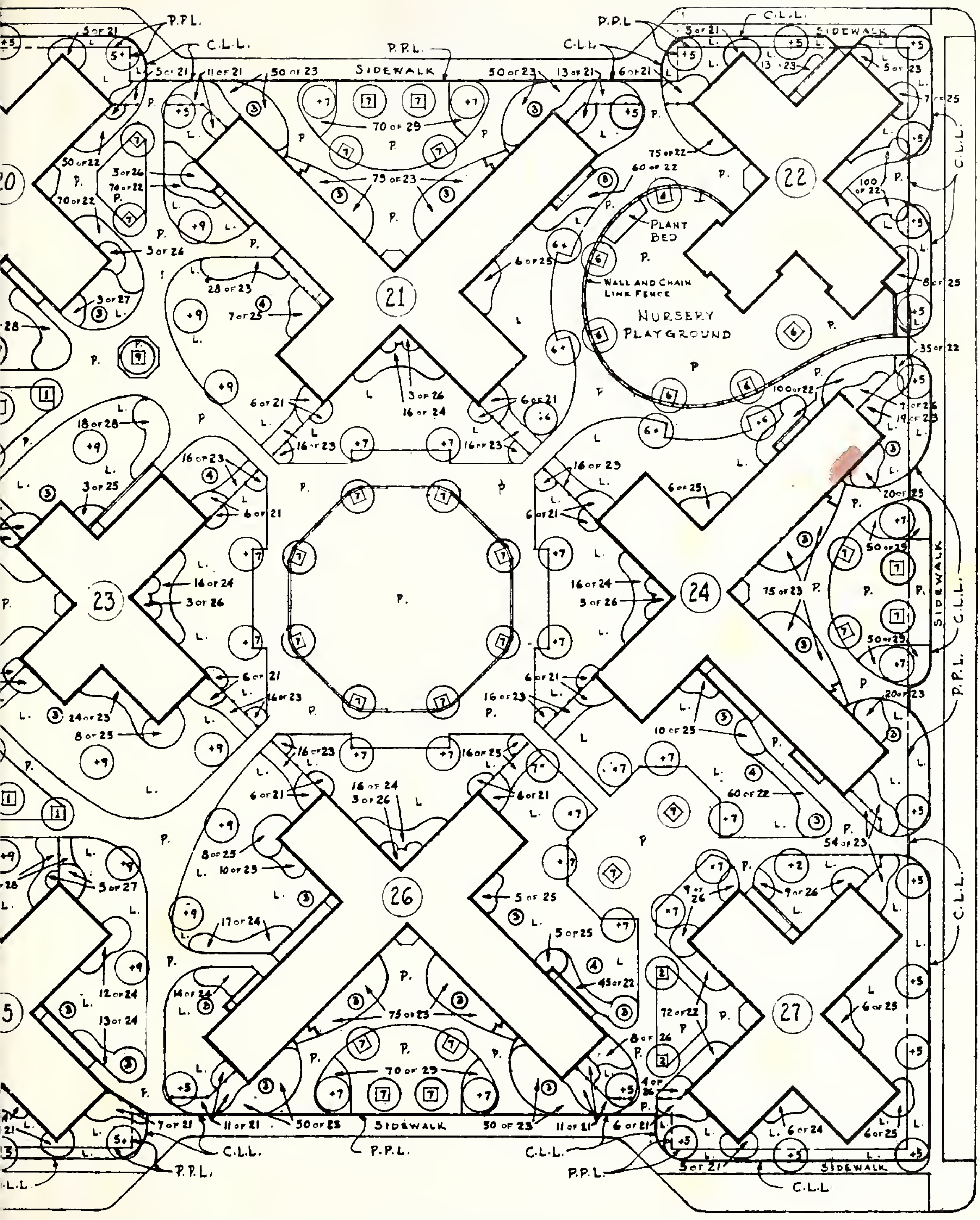


Fig. 5. Plot plan of Brownsville Houses.

Fig. 6. East River Houses, New York City. Voorhees, Walker, Foley and Smith; Alfred Easton Poor, and C. W. Schlusing, architects; Alfred Geiffert, Jr., landscape architect. Sketch by Chester B. Price.

Existing topography will in great measure determine the location of the surface utilities on the basis of percentage of grades relative to traffic movement and areas to be drained. On flat sites we find fewer grading problems, though it may be necessary to force grades to give an adequate flow to surface drainage. This applies particularly to roads, parking areas, and paved play areas.

For rolling or steep sites the area of these surface utilities increases, for in order to provide any or all of the aforementioned features a greater amount of grading may be necessary and the problem of constructing steps, ramps, retaining walls and catch basins for drainage arises. The paved areas for traffic, parking, and safety must be reasonably level, whereas the areas used for recreation whether paved or simply grassed may well be sloped.

Recreation areas (Fig. 7) include not only actual play areas such as handball courts, volley ball courts, horse shoe pits and like installations but any open area that can be either used or simply seen and enjoyed. Recreational requirements will differ with due regard to any existing facilities in the vicinity. For example, a large park near an apartment community will supply a place where the entire family may go to enjoy sunshine, shade, individual or organized games. Too seldom do we find such a pleasant situation and we must therefore supply for our residents what the allotted space will afford.

The average housewife who has children appreciates a place where those of preschool age may amuse themselves without worry about passing autos jeopardizing their safety. Her elder children would no doubt be bored with sand boxes, slides, and seesaws in a fenced enclosure and would rather play soft ball or catch on an open grass area. The mother with a new baby wants a place to wheel her carriage and park it in the sunshine while she sits on a nearby bench exchanging gossip with her neighbor.

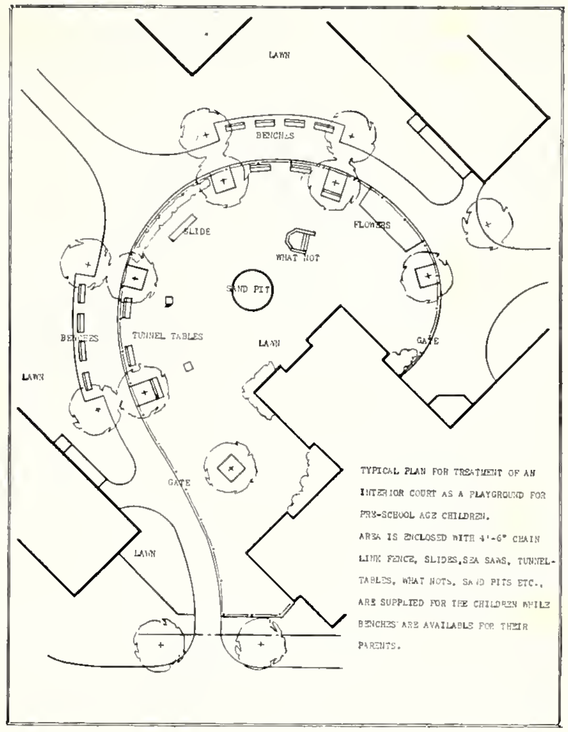


Fig. 7.

Daddy too enjoys these benches in the cool of the evening and on sunny weekends. So then, where possible, recreational areas should provide these uses. They should be accessible to the units they serve and also be tied into the all important system of circulation.

Orientation

Orientation as applied to the development of an apartment house community means simply this: placing the involved elements—buildings, surface utilities, as well as recreational areas—to take full advantage in their relationship to to all existing conditions.

We know that the sun rises in the East and sets in the West. We know for any given section of the country what weather conditions prevail—severe winters, hot summers, from what direction we may expect bitter cold winds, cool summer breezes, etc. In order to gain the maximum benefits the site affords we must so fit our homes to the ground to make them attractive and functional as possible in the light of these conditions affecting the immediate locality.

Among the first things that man became aware of was the sun. Sun, shade, meant heat and cold. Wind and rain mean discomfort. Then, as now, man is aware of these elements and they play an important part in his habits of living.

It is not always possible to have each building placed so that it has sunshine where its tenants want it, for in our large city projects where we have buildings of ten or more stories closely grouped, they themselves will often obscure the sun from sections of each other. Only by plotting the path of the sun through the seasons by the use of scale models and controlled lights can we see exactly what happens to our buildings in their planned positions and make what adjustments are possible to improve the layout (Fig. 164, page 118).

The problem of correct building placement with regard to prevailing winds has been more or less solved by our present day construction methods. We no longer find it necessary to worry about cold drafts through windows, doors, or walls. Our heating, cooling, and ventilating systems are capable of making the interior temperature comfortable at all times and under all conditions.

During the process of locating our buildings we must keep in mind that remaining area which is ours to treat as recreational. Here, again, we must consider it in relation to the buildings and the elements. Tennis courts and ball diamonds should be placed so as to afford maximum comfort for both contestant and spectator, oriented north and south. Sitting areas should provide both shade and sun if it is impossible or impractical to place them with regard to existing trees or tree groups we must create our own planted settings.

In creating these settings and the general planting throughout the area. after the area has been allocated, we must use plant material whose growing habits conform to the existing environment. For example, certain trees and shrubs will not survive in an exposed windswept area but will grow well if afforded some protection. Certain vines will do well in bright sunshine while others do better in a shaded spot. Knowing the growing habits of plant materials we are able to choose the right type of material for any given spot.

Three Dimensional Consideration

Composition is a relationship of volume to space. In our apartment house community our buildings are the volume, their mass outline, individually or collectively from any point of view is the most important element in the composition. The space surrounding them and its treatment through the use of trees and shrubs adds to and becomes a complimentary part of the composition.

As the entire project will not be seen from any given point and because man's angle of vision is limited and it is for him as an individual we are creating the composition, it takes on a more intimate or human value.

It becomes only a portion of a building with its complimentary surroundings that greets his eye—just one picture of thousands that are created within the development. We must, in creating our mass composition, consider the details in these individual pictures—and make each as pleasant as possible. The near view or close at hand picture, as well as far view, must be considered by the designer and solved by use of a pleasing relationship of many planes and individual masses or objects to a focal point. These views will be seen not only from the earth's surface but from varying window levels throughout the community and therefore the focal point will move accordingly. From the higher levels the horizontal plane will be much more in evidence and the vertical planes distorted. The pattern of paths, roads, trees, and planted areas will enter into this picture. From eye level on the ground the horizontal plan and its pattern is lost and the vertical lines, masses, and planes make up the elements of the picture.

Another condition arises in creating our composition—the use of light. In daylight even without sunshine there is light and shade. Sunlight intensifies these and adds shadow. As the earth changes its position in relation to the sun (Fig. 164, page 118) so the lighting on our pictures change from dawn to dusk and season to season, so too do the color values of the various elements involved.

At night light becomes essential as a safety factor to guide our movements either on foot or by motor. These will be in the form of lights on standards along roads and paths and lights on individual buildings to light entrances and exits.

The studies made for the system of traffic circulation and the relative importance of each route will determine the type and location of the necessary lights. In the placement of these and any additional lights we should also consider using it to illuminate some of the more pictorial compositions of beauty—a beauty of a mysterious quality not achieved in daylight which adds so much to sensitive living.

An important all over consideration in developing our finished plan is the choice of materials—both structural and planting. Nature and man's ingenuity have provided us with a wide variety of building materials and an even greater variety of plant life. With all these available it becomes a matter of choosing those that will blend well and harmonize with the surroundings.

In choosing the materials with which to build our composition, one important factor will be existing buildings and structures in the immediate vicinity of our project. If our community is to be built in an area which already contains, for example, only brick and stone houses in a definite style and we choose to build in an altogether different one using concrete, steel, glass blocks and wood, the contrast would certainly be evident. Depending upon the neighborhood this might be preferable, for if the surrounding buildings are dilapidated and will possibly be demolished and rebuilt in the near future our buildings may set the style and pattern for their rebuilding. On the other hand if our community is being built in an area containing similar housing installations with buildings that may have the same life span or even outlive our project, we must by all means give consideration to harmony with them.

Structural Materials

After the materials for our buildings have been selected comes the problem of choosing suitable materials with which to construct the "surface utilities." A study of the established roads, walks and walls in the vicinity will be helpful and show whether their construction was practical from the standpoint of durability and cost. Then, providing color, texture, and scale are suitable we may consider their use in our project.

Though progress has been made in road surfacing, a good road still depends on a sound, well drained sub-base to support the ballast on which the wearing surface is placed. For our purpose the choice of road types is limited to concrete, water-bound or bituminous bond macadam with or without an applied wearing surface.

It is in the wearing surface that variety of color may be achieved by the use of colored stone aggregate in the mix and as a rolled-in surface dressing.

In the choice of road types the determining factors are its use by heavy or light vehicles, grades, condition of sub-base, whether to be laid on cut or on fill and adequate drainage.

Traffic to which the road will be subjected will determine the thickness of the base and wearing courses. If the road must be laid on heavy fill where settlement is bound to occur, it is inadvisable to install a concrete road, for the settlement will undoubtedly cause cracks and an uneven surface.

Parking areas which are not used for heavy traffic, can be of lighter construction, with ensuing economy.

For a hard surfaced play area—a hand ball or tennis court—either concrete or bituminous pavement can be used with equally good results—with a minimum of maintenance as one of its advantages over a clay surfacing.

The selection of a material to use for walks is determined in much the same manner as for roads, however we have a larger range of materials to choose from. In addition to concrete, bituminous and gravel, we have flagstone, brick, granite block or stabilized earth, each having a distinct character of its own, with varied possibilities for pattern.

In the construction of walls we are more limited. We have a choice of concrete, concrete with a veneer of brick or stone, or a solid masonry wall. In determining our choice for a specific site, cost is usually the governing factor. The availability of usable stone on the site will be given first consideration provided the color, texture and scale conform harmoniously with the materials of which the buildings are constructed.

Curbs for roads and walks offer opportunity for the use of concrete, bluestone or granite block. Brick is also used at times. The use of curbs on roads, walks and around parking areas has advantages—a clean cut alignment, use as a side gutter, and easier mowing of abutting lawn areas.

Planting Materials

In the selection of our plant materials we must remember that we are dealing with living materials which have set habits of growth. They may change color throughout the seasons, shed their leaves or needles, grow rapidly or slowly, tall or spreading or in many ways change during their lifes' span.

We have a wide variety to choose from and are limited in our choice only in that the material be indigenous to the locality.

What better proof is there of what will grow in a given area than what is natively already growing there, to which we add what we have learned from experience will grow under similar conditions.

Trees, shrubs, ground cover, vines and grass complete the growing elements in our planting compositions. Flowers in a project of this nature have proven unsatisfactory as they present a complex maintenance problem and seem to vanish quite mysteriously—only to appear later on some window sills or dining room tables. The same is often true of flowering trees and shrubs. A choice of what materials for what uses becomes our problem with consideration given to a minimum of maintenance involved in their upkeep.

Trees, deciduous and evergreen to give shade, color and scale, can be used in rows or as isolated specimens. Among the hardiest shade trees growing under city conditions, we may include *Platanus Orientalis*, "Oriental Plane," *Ginkgo*—"Maidenhair tree," *Quercus palustris*—"Pin Oak," *Tilia europaea*—"European Linden," and not to be forgotten is the hardiest of all *Ailanthus*—"Tree of Heaven."

Trees, small and flowering, add their note of charm to our composition with color and

form. Among the varieties found most hardy we include *Malus Floribunda*—"Japanese Flowering Crab," *Crataegus crusgali*—"Cockspur Hawthorn," *Crataegus phaenopyrum*—"Washington Hawthorn," *Crataegus oxyacantha*—"English Hawthorn," *Prunus subhirtella* and *Prunus serrulata*—"Flowering Cherry," *Cornus Florida*—"Dogwood," white and pink.

Hedges have a variety of important uses which offset their maintenance problem of clipping to form. They are used to screen out an objectional view, guide pedestrian traffic over a specified route and discourage short cuts through restricted areas, or simply to supply long green horizontal lines to relieve the monotony of many vertical lines or planes. For our hedge materials we found, among the evergreens the following useful varieties—*Taxus Cuspidata*—"Japanese Yew," *Taxus media*—"Anglo-Jap Yew," and other specimens of this plant. *Ilex Crenata*—"Japanese Holly," *Tsuga Canadensis*—"Canadian hemlock," have served us well. Among the deciduous plants we rate highly are *Ligustrum obtusifolium reglianum* of the "Privet" family, *Crataegus*—"Hawthorn" family, and *Berberis Thumbergi*—"Japanese Barberry."

Shrubs—here we have an abundance of varieties, with many types of bloom and color to choose from, with varied maximum heights of growth, to suit our needs for form and color in our composition. We name only a few of the best suited varieties, of the better growing plants *Syringa vulgaris*—"Lilac," *Symphoricarpos racemosus*—"Snowberry," "Forsythia," *Viburnum tomentosum* and *dilatatum*—"Double file and Linden Viburnum," *Weigela floribunda*—"Crimson Weigela," *Philadelphus coronarius*—"Sweet Mock Orange," *Cydonia japonica*—"Japanese Flowering Quince," Spirea in variety, and *Kalmia latifolia*—"Mountain Laurel," *Pieris floribunda*, *Andromeda* of medium height, and *Deutzia gracilis*, *Cotoneaster horizontalis*, *Hypericum calycinum*—"St. Johnswort," growing to approximately 2′.

Vines and ground cover add a very useful note in color and texture to our composition. A rich green vine, *Hedra Helix*—"English Ivy" for example, climbing up a building in interesting pattern will do much to offset a drab brick or stone wall. Similarly other vines may be used—*Parthenocissus tricuspidata*—"Japanese Creeper," with fairly large leaves—of the same family *Parthenocissus tricuspidata lowi* has much smaller leaves. Then we also add *Euonymus radicans vegetus*—"Big leaf winter creeper Euonymus," *Lonicera japonica halliana*—"Hall's Japanese Honeysuckle," *Celastrus scandens*—"Bittersweet," *Polygonum auberti*—"Silverlace vine," for consideration.

In small areas restricted by platforms, walks, areaways and similar obstructions which make them inaccessible to a lawn mower, ground cover comes to do its part in our overall composition. There are a few varieties we have used with success, *Hedra Helix*—"English Ivy," *Vinca Minor*—"periwinkle," *Pachysandra terminalis*, *Euonymus radicans*. They not only serve as a ground cover, but lend a color note in contrast to our lawn, and shrub areas.

Lawn areas of large size are ever striven for, though difficult to achieve in most apartment house communities. Nothing does more to give scale and give a feeling of free breathing. Much is written on lawns, preparation of soil, seeding and maintenance. One word of caution. Use at the outset a good topsoil, properly prepared, properly handled, and carefully select a good grass mixture, thereby insuring for a long time a fine lawn easy to maintain.

Bibliography

DESIGN

There are many books on housing and on city planning, both of which are subjects in which the apartment designer should be thoroughly informed, as they have had a great influence on apartment design and promise to be even more influential in the future. An extensive bibliography on city planning will be found in **The Culture of Cities** *by Lewis Mumford, Harcourt-Brace, 1938. This book is also the best general survey of the subject. The best general survey of housing is* **American Housing** *by Miles L. Colean, et. al., The Twentieth Century Fund, 1944. This book contains an extensive bibliography on housing.*

No attempt has been made here to include books on general architectural subjects, data books, or standard handbooks, as it is assumed that the architect and engineer are familiar with the general literature in their fields. The amount of published material devoted to apartment house design is very limited, and most of it is scattered through various architectural magazines and government pamphlets. The following list contains most of the material which I have been able to find on the subject.

Joseph H. Abel

BOOKS

Hitchcock, Henry Russell. *In The Nature of Materials* (The Buildings of Frank Lloyd Wright). New York: Duell, Sloan & Pearce, Inc., 1942. This book contains plans and renderings of several very interesting and ingenious apartment buildings which have unfortunately never been built. The designs are well worth careful study.

John B. Pierce Foundation. *Family Behavior, Attitudes and Possessions.* New York: John B. Pierce Foundation, 1944. Deals solely with bedroom, bath, and storage areas. Contains considerable information of interest.

Justement, Louis. *New Cities for Old.* New York: McGraw-Hill Book Company, Inc., 1946. Principally about city planning, this book contains an interesting discussion of several apartment financing schemes.

Le Corbusier. *City of Tomorrow and its Planning.* New York: Harcourt-Brace, 1929. Contains many stimulating ideas on apartment buildings and city planning.

McGonagle, J. R. *Apartment House Rental, Investment and Management.* New York: Prentice-Hall, Inc., 1937. Written principally for apartment house managers and real estate operators. Contains little of interest to architects or builders.

Sexton, Randolph W. *American Apartment Houses, Hotels and Apartment Hotels.* New York: Architectural Book Publishing Co., Inc., 1929. Devoted almost entirely to plans and photographs of large buildings built during the twenties mostly in New York City. Not very useful.

Von der Bent, Teunis J. *The Planning of Apartment Houses, Tenements and Country Houses* (1917). Of historic interest only. Buildings shown are of a type long since outmoded.

Wright, Henry. *Rehousing Urban America.* New York: Columbia University Press, 1935. Contains several chapters on apartment design, the remainder of the book being on housing in general. There is a considerable amount of valuable general data on housing standards, orientation, etc. The author is in favor of the two and three story garden apartment; a point of view which I have opposed in this book.

Yorke, F. R. S., and Gibberd, Frederick. *The Modern Flat.* London, England: The Architectural Press, 1937. The short text includes a discussion of the history and evolution of apartment design. The balance of the book is devoted to an excellent collection of pictures and plans of apartment buildings, principally European examples.

GOVERNMENT PUBLICATIONS

Federal Housing Administration. *Architectural Planning and Procedure for Rental Housing* (1939).
———. *Low Rental Housing for Private Investment* (1940).
———. *Minimum Requirements for Rental Housing Projects* (1942).
———. *A Survey of Apartment Dwelling Operating Experience in Large American Cities* (1940). Out of print.
———. *Four Decades of Housing With a Limited Dividend Corporation* (Form No. 2208).

Federal Public Housing Authority (NHA). *Minimum Physica Standards and Criteria* for the Planning and Design of FPHA-aided Urban Low-Rent Housing (1945).
———. *Public Housing Design*, A Review of Experience in Low-Rent Housing (1946).
———. The Livability Problem of 1,000 Families (1945).

MAGAZINE ARTICLES*

Architectural Record. "Housing from the Tenant's Viewpoint," a graphic presentation of Miss Coit's article (Dec. 1939).
———. "Portfolio of Small Houses and Apartment Buildings" (Oct. 1936).
———. "Apartments" (Portfolio, Oct. 1944).
———. "Buckingham: Housing Laboratory" (Jan. 1938).
———. "Low Rent Apartments," by Frederick L. Ackerman and Lafayette Goldstone, Architects; Sullivan A. S. Paterno, Consulting Engineer; Fred N. Severud, Structural Engineer (Jan. 1946).

Progressive Architecture (formerly Pencil Points). "Three Privately Developed Apartment Houses." Richard J. Neutra, Architect (Jan. 1944).
———. "Kollektivhuset Marieberg." Sven Ivar Lind, Architect (Sept. 1945).
———. "Stuyvesant Six," A Redevelopment Study. Marcel Breuer, Architect (June 1944).
———. "Sweden's Housing Solution," Kollektivhuset in Stockholm. Sven Markelius, Architect (Sept. 1945).
———. Cooperation Between Architects and Engineers," by Paul Weidlinger (June 1946).

The Architectural Forum. "Horse Sense Planning," by Albert Mayer and Julian Whittlesey (1933 and 1944).
———. "A Plan for Harlem's Redevelopment." William Lescaze, Architect (Apr. 1944).
———. "Family Behavior, Attitudes and Possessions." A discussion of the book of the same name (June 1944).
———. "Metropolitan's Parkchester." (Dec. 1939).
———. "Rockefeller Apartments." Wallace K. Harrison and J. Andre Fouilhoux, Architects (Jan. 1937).
———. "Garden Apartments" (May 1940).
———. "Channel Heights Housing Project." Richard J. Neutra, Architect (Mar. 1944).
———. "Portfolio of the Work of Berla and Abel." Berla and Abel, Architects (Aug. 1946).
———. "The Hospital Builds a Housing Project." Michael Reese, Planning Staff; Walter Gropius, Architectural Consultant; Walter H. Blucher. Planning Consultant (Sept. 1946).
———. "Housing Standards," A Preliminary Report of the Committee on Physical Standards and Construction of the National Association of Housing Officials. A. C. Shire, Chairman; Henry S. Churchill, Secretary (May 1938).

The Octagon. (Journal of the American Institute of Architects.) "Notes on the Design and Construction of the Dwelling Unit for the Low-income Family," by Elizabeth Coit (Oct. and Nov. 1941).

* The above list of magazine articles does not pretend to be a comprehensive list of all articles published nor of all presentations of individual buildings or projects. It merely represents an assortment that I have personally found useful or interesting.

HEATING

Adlam, T. Napier. *Radiant Heating.* New York: The Industrial Press (Publishers of *Heating and Ventilating*) 1947.

Allen, John R., and Walker, James Herbert. *Heating and Air Conditioning.* New York: McGraw-Hill Book Company, Inc., 1946.

Carrier, Willis H., Cherne, Realto E., and Grant, Walter A. *Modern Air Conditioning, Heating and Ventilating.* New York: Pitman Publishing Corporation, 1940.

Heating, Ventilating and Air Conditioning Guide. New York: American Society of Heating and Ventilating Engineers (published annually).

Holmes, Richard E. *Air Conditioning in Summer and Winter.* New York: McGraw-Hill Book Company, Inc., 1938.

Jennings, B. H., and Lewis, Samuel R. *Air Conditioning Principles and Practice.* Scranton, Pennsylvania: International Textbook Company, 1939.

Konzo, S., Editor. *Winter Air Conditioning, Forced Warm-Air Heating.* Cleveland: National Warm Air Heating and Air Conditioning Association, 1939.

Raber, B. F., and Hutchinson, F. W. *Refrigeration and Air Conditioning Engineering.* New York: John Wiley & Sons, Inc., 1945.

Severns, William H. *Heating, Ventilating and Air Conditioning Fundamentals.* New York: John Wiley & Sons, Inc., 1937.

Trane Air Conditioning Manual. LaCrosse, Wis.: The Trane Company, 1938.

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